
Columbia Venture, LLC

Richland County, South Carolina

Appeal to Technical

Information from FEMA

Presented 26 September 2000

Revision 0

26 October 2000

Project Number 006217.01

LOCKWOOD GREENE

Consulting • Design • Construction

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26 October 2000

Mr. Michael K. Buckley, PE
Director
Technical Services Division
Mitigation Directorate
Federal Emergency Management Agency
Washington, DC 20472

Dear Mr. Buckley:

Subject: Congaree River – Lexington and Richland Counties
Appeal to FEMA Presented Information (26 September 2000)

We have reviewed the information presented by FEMA for the Flood Study on the Congaree River. Our comments are provided in the attached documents.*

We look forward to resolution of the floodway/floodplain issues. Feel free to call Mr. [REDACTED] or me [REDACTED] for clarifications or questions.

Sincere regards,

LOCKWOOD GREENE
[REDACTED]

Division Manager

Enclosures: * Due to the size of the electronic files, this letter and attachments are being e-mailed and FedEx directly to Mike Buckley and [REDACTED] separate from Columbia Vneture's letter of 26 October 2000.

1. S&ME Geotechnical Evaluation
2. Appeal of Technical Information from FEMA presented 26 September 2000
3. HEC-2 Files and Summaries

cc: [REDACTED] [REDACTED]

Appeal of Technical Information from FEMA presented 26 September 2000

26 October 2000

Contributions By:



S&ME
John R McAdams Company
Lockwood Greene
Lockwood Greene
S&ME
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SCHEDULE

■ Preparation Time

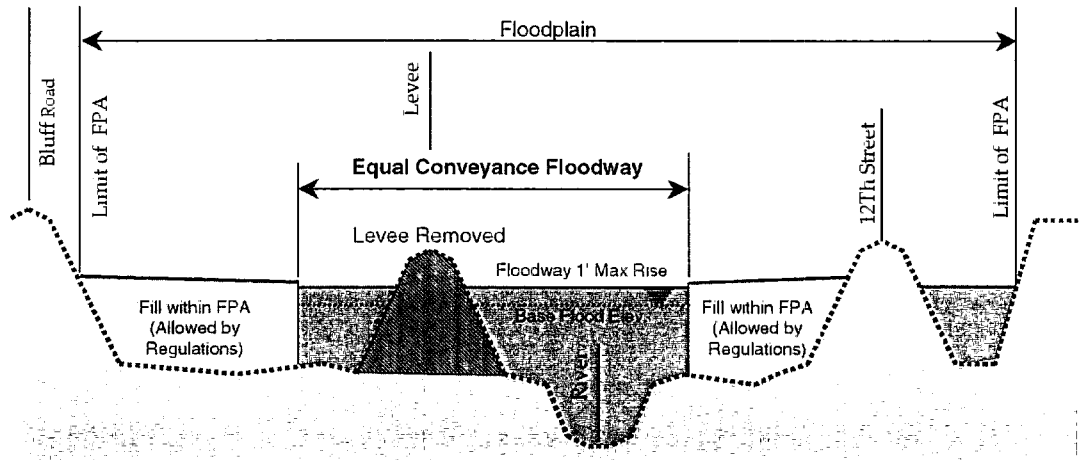
- FEMA changed the method of analysis from entirely HEC-2 based to RMA-2 and HEC-2 combination. The RMA-2 is a specialized model that requires significant review time. We have not had opportunity to thoroughly review and comment on the RMA-2 models in a 30-day period.
- HEC-2 models and resulting mapping are completely different; therefore, extended review is required. Also the HEC-2 models were significantly revised by FEMA on 18 October 2000. We have not had opportunity to thoroughly review and comment in a 7-day period.

FLOODWAY DETERMINATION

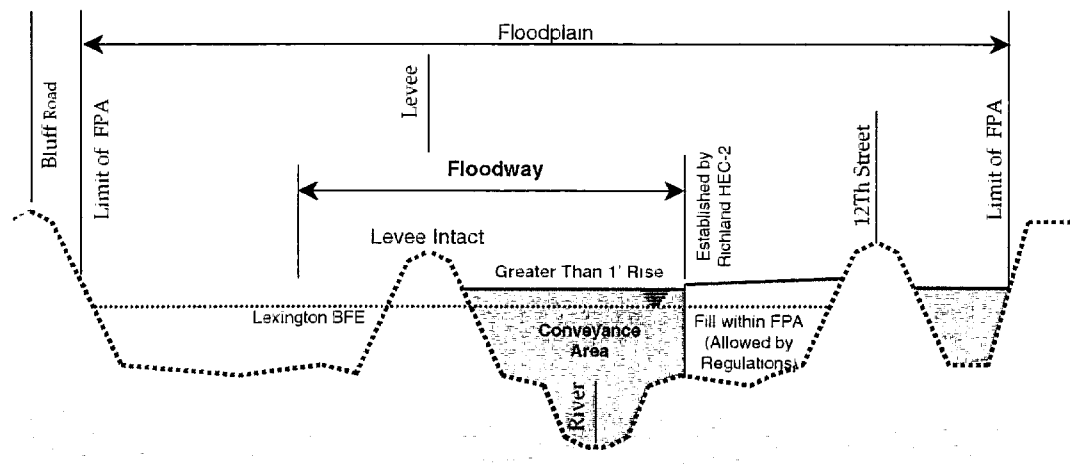
■ FEMA Floodway

- By using the Richland County HEC-2 model (levee out) for floodway determination increases the risk of flooding.
- FEMA's currently proposed floodway assumes a condition that may not occur, as described below:
 - Flow conveyance occurs for full width of floodway.
 - Levee is removed as a barrier or impediment to flow by the floodway.
 - Richland and Lexington Counties are developed (new construction) to floodway limit.

See the following illustrations:



- The highest potential for flooding exist when:
 - The levee remains intact as barrier to flow.
 - Lexington is fully developed (new construction) to the floodway limit.
 - Flow does not occur for the full width of the floodway.



- In order to maintain 1' maximum surcharge Lexington floodway should be set with levee intact. Use the Lexington HEC-2 model (levee in) for Lexington County Floodway.

HYDROLOGY

■ General

- The Lake Murray 100-year discharge flow rate of 22000 to 25000 cfs presented from Mr. Neville Lorick of SCANA was not included into FEMA's calculation for the 100-year flow rate.
- Use the soon to be provided (by SCANA) Lake Murray routing in the computations of the 100-year flow rate on the Congaree River at Gervais Street.

GEOTECHNICAL EVALUATION

■ General

- Refer to the geotechnical evaluation prepared by S&ME that indicates the probability of levee failure.
- The probability of levee failure is low based on US Army Corps of Engineers technical procedures.
- The probability of a double breach scenario is unlikely.

2-D MODEL (RMA-2)

■ General

- The FEMA RMA-2 model is run as a steady state model, and the results indicate a "snap shot" in time. This particular method does not account for breach or failure occurring over time, hydrograph (inflow) duration, and constantly varied quantity of water filling the area. The RMA-2 model must be run as a time varied model to obtain accurate results.
- The steady state RMA-2 model results have been misinterpreted. FEMA interpreted the steady state model velocities greater than 1 foot per second north of I-77 as effective flow, but the model simply shows that the area is filling. This is confirmed by the following facts

taken from the double piping breach scenario (refin.geo and refin129.sol) at 292,000 cfs:

- Velocities greater than 1 fps are only located at the FEMA imposed breach locations and the I-77 bridges.
- Velocities that are greater than 1 fps are generally perpendicular to the Congaree River at the south breach.
- Areas approaching the I-77 bridges in Richland County have velocities less than 1 foot per second. Velocities only exceed 1 foot per second passing through the bridges.
- Richland County downstream of I-77 has velocity less than 1 foot per second. See Figure 2.
- The steady state model indicates a double breach scenario. Refer to the S&ME prepared geotechnical evaluation that indicates that this occurrence is highly unlikely.

■ Geometry

- The geometry mesh should extend upstream from the point of interest (levee) including left and right overbanks. Expand the mesh to include topographic information from the high ground north of the boat ramp and existing levees along both quarries. The lack of mesh in this area impacts the model results at the most northern portion of the levee. The geometry mesh must be expanded a sufficient distance to prevent boundary conditions from influencing the results near the levee. Please refer to the previously submitted Lockwood Greene aerial photograph.
- Gills Creek is not modeled correctly in the mesh geometry. Please refer to the previously submitted Lockwood Greene topographic information.
- The existing levee circling north and south of Gills Creek is missing from the mesh geometry. Please refer to the previously submitted Lockwood Greene topographic information.

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- The existing levee separating levee section 1 from levee section 2 is missing in the mesh geometry. Please refer to the previously submitted Lockwood Greene topographic information.
 - The area surrounding the City of Columbia WWT facility (noted as Area 1 on Figure 1) is indicated as a wet/dry boundary, but this may not be appropriate since grade at the wastewater treatment plan varies from 127 – 140 feet in elevation. Figure 1 taken from the FEMA provided double piping breach scenario (refin.geo and refin129.sol) files indicate that the water level is approximately 131 to 133 feet; therefore, portions of the area should be excluded from the wet/dry boundary.
 - The wet/dry boundary located north of Heathwood Hall (noted as Area 2 on Figure 1) is not appropriate since elevation in that area is approximately 130 feet based on the USGS map (topographic survey is not available). Figure 1 taken from the FEMA provided double piping breach scenario (refin.geo and refin129.sol) files indicate that the water level is approximately 137 to 134 feet; therefore, the area should be excluded from the wet/dry boundary. The removal of this wet/dry boundary will reduce the velocity in the northern area of the levee interior.

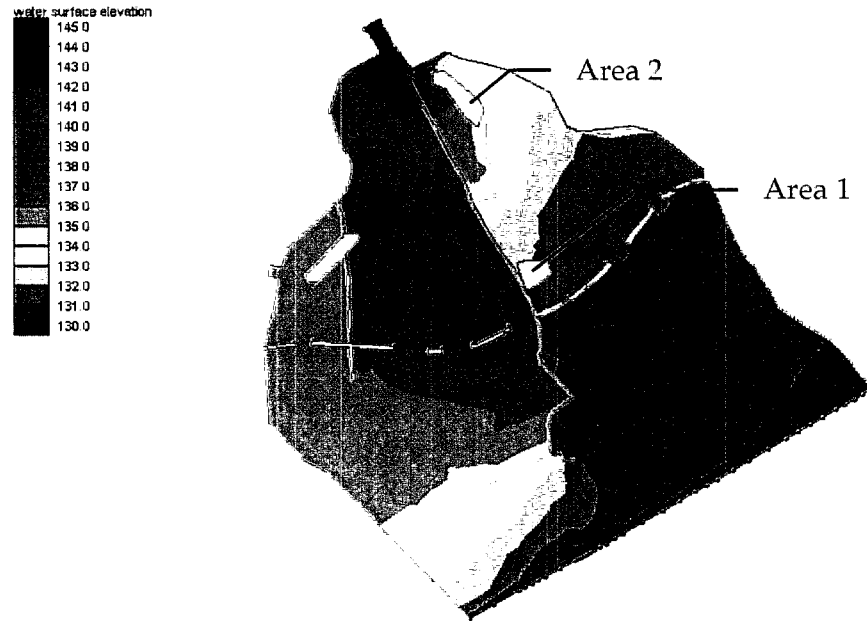


Figure 1 – FEMA Hydraulic Grade Elevation

- The FEMA prescribed breach on the northern most levee is blocked by an existing cellular or looped levee. The interior levee forms a cell around the breach. The top of this existing interior levee ranges from elevation 136 (in one narrow location) to elevation 141 in most locations. Please refer to the previously submitted Lockwood Greene topographic information.

■ Velocity and Effective Flow

- On page 19 of the “Appeal Resolution for Congaree River in Richland and Lexington Counties, South Carolina” document, effective flow behind the levee is defined as water velocity greater than 1.0 foot per second. Figures 2 and 3 taken from the FEMA provided double piping breach scenario (refin.geo and refin129.sol with $Q=292,000$) files indicate that the water velocity is less than 1 foot per second south of I-77; therefore, portions of the area should be defined as ineffective flow. In fact the areas north of I-77 cannot be considered effective flow when it does not pass through the downstream portion of the property as effective flow.

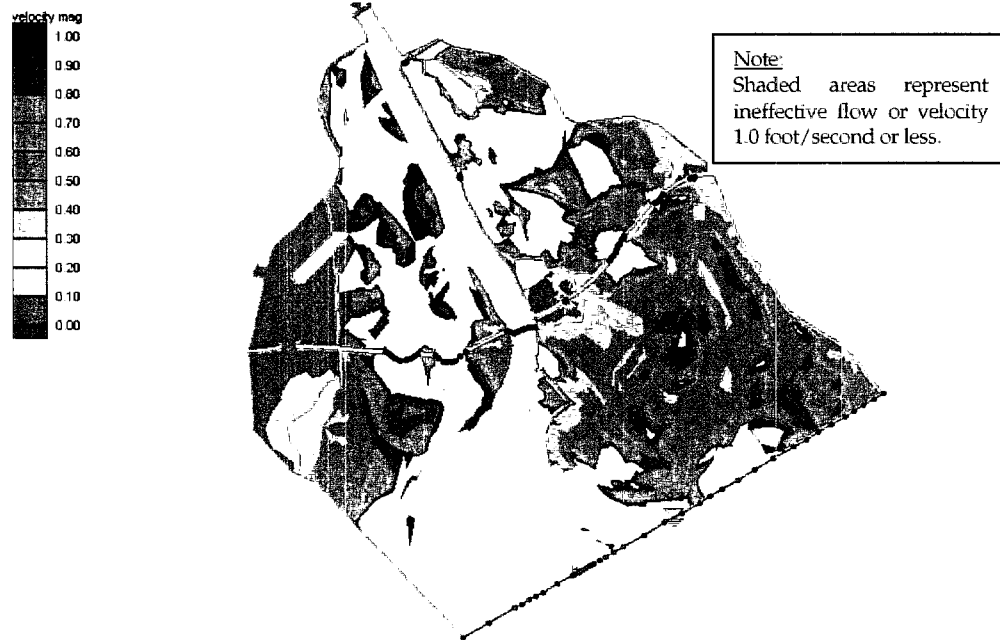


Figure 2 - Velocity Less Than 1 Foot per Second at Q = 292,000 cfs

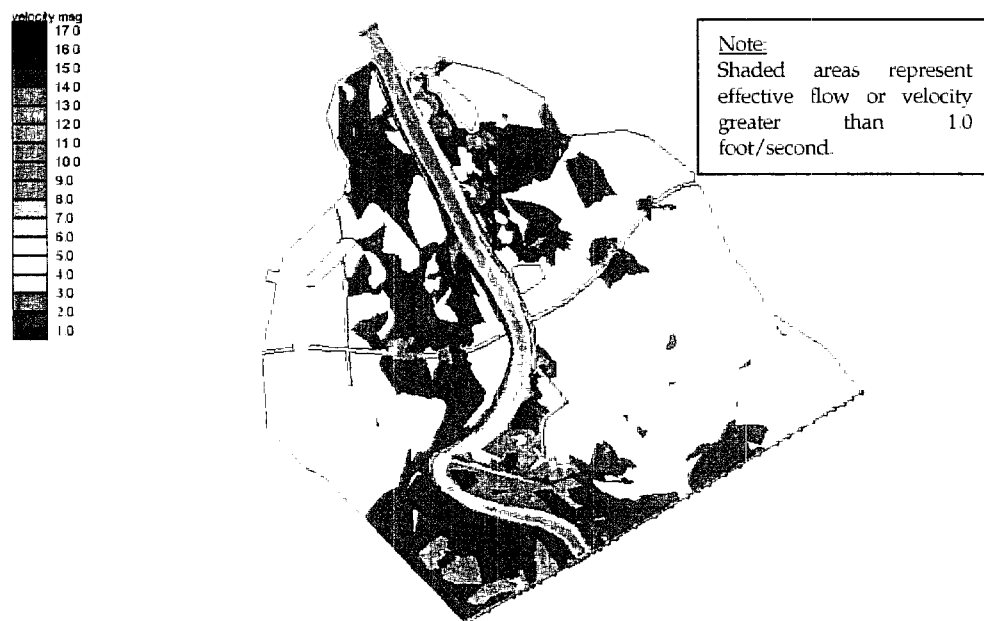


Figure 3 - Effective Flow, Velocity Greater Than 1.0 Foot per Second at Q= 292,000 cfs

■ Boundary Conditions

- Boundary flows are not present for Gills Creek or Congaree Creek. Omitting this information may change RMA-2 model results. Evaluations of the flow additions are difficult to predict since the points of addition are on the fringe of the floodplain and controlled by backwater from the Congaree River.

■ RMA-2 Summary

- Model needs to have several corrections made, but calibrates fairly well with the Lexington HEC-2 model.
- Corrections to RMA-2 model will improve calibration with Lexington HEC-2. See the following section.
- Flows in Richland County are ineffective south of I-77 and are ineffective in specific areas north of I-77.

HEC-2 MODEL

■ Methodology

- Page 7-4 of FEMA 37 states that the equal conveyance reduction method is to be considered “if technically appropriate.” This particular section for FEMA 37 appears to be written for small un-certified agricultural levees. The existing Manning levee exceeds the 100 BFE and in some locations exceeds the 500-year elevation. In this case the floodway in Lexington County should be established per the same method as the BFE, which uses the levee in-place.
- FEMA has ignored the existing levees along Gills Creek and the levee separating section 1 from 2. These levees cause water to be retained within the site producing ineffective flow interior to the existing levees. In this case FEMA has under estimated the BFE in Richland County since the water will pool to the same elevation as the outside of the levee. The Richland County BFE will equal the Lexington County BFE once the levee area fills with water.

■ BFE Comparison

- BFE correlations between the RMA-2 and Richland HEC-2 model are poor. See the following BFE comparison table:

T a b l e 1					
HEC-2 Station	Approximate 100 Yr WS Elevation				
	RMA-2		Richland HEC-2 ¹	Difference	
	@ Levee	@ Bluff		@ Levee	@ Bluff
253400 - E	137.0	133.5	140.0	3.0	6.5
249300 - D	135.0	132.0	138.0	3.0	6.0
246700 - C	133.0	132.0	137.5	4.5	5.5
234100 - B	130.5	130.5	134.5	4.0	4.0

The Richland HEC-2 model consistently yields a result 3.0 to 6.5 feet higher than the RMA-2 model for Richland County.

- BFE correlations between the RMA-2 and Lexington HEC-2 model are more consistent. See the following BFE comparison table:

T a b l e 2			
HEC-2 Station	Approximate 100 Yr WS Elevation		
	RMA-2 @ Levee	Lexington HEC-2	Difference
253400 - E	142.5	142.0	0.5
249300 - D	140.0	141.5	1.5
246700 - C	138.5	140.0	1.5
234100 - B	135.0	135.5	0.5

- The Lexington HEC-2 model appears to approximate the RMA-2 model results; therefore, the Lexington HEC-2 model is the appropriate model to use for BFE and floodway computations.
- The RMA-2 model yields higher 100-year flood elevations on the Lexington side of the levee versus the Richland side. This indicates that the floodway is not split equally about the levee; therefore the floodway should not be computed per the equal conveyance method.

¹ From 26 September 2000 Richland County FIRM map

■ Geometry

- The RMA-2 model prescribes a 2-breach scenario where water may enter (or exit) the levee interior. The Richland HEC-2 model does not use the levee to restrict the movement of water. In the unlikely event of a 2 breach scenario the remaining levee would affect water movement. The Richland HEC-2 model should follow the same assumptions as the RMA-2 model.
- Because the assumptions are not consistent between the two models the Richland HEC-2 model provides unrealistic output.
 - The Richland HEC-2 model has an increase of flow on the left overbank (Richland County side) that does not correspond to the location of the breach. This is not physically possible based on the assumptions of the RMA-2 model. Also the Richland HEC-2 model has a decrease of flow on the left overbank just before the I-77 bridges that does not correspond to a breach location. See the following comparison:

T a b l e 3				
	HEC-2 Station	RMA-2 Breach Location	Richland HEC-2 Left Overbank ² Flow (cfs)	Change
	254500	none	0	-
E	253400	120' Wide	42629	Increase
	250770	none	75515	Increase
	249590	none	99585	Increase
D	249300	none	95088	Increase
	248200	120' Wide	114418	Increase
	247200	none	114092	Increase
	247000	none	109637	Decrease
C	246700	none	179583 ³	Increase
	246000	none	141602	Decrease
	245800	none	136984	Decrease

² Left overbank represents the area outside the channel in Richland County per HEC-2 definitions.

³ Left overbank flow rate exceeds quantity in channel (Congaree River)

T a b l e 3				
HEC-2 Station		RMA-2 Breach Location	Richland HEC-2 Left Overbank ² Flow (cfs)	Change
	243000	none	96998	Decrease
	242440	none	80480	Decrease
Bridges	I-77 Bridges 242241 thru 242049	none	33992	Decrease
	241850	none	59742	Increase
	241500	none	57205	Increase
	239800	none	73674	Increase
	239370	none	96109	Increase
	238900	none	101246	Increase
B	234100	none	66336	Decrease

Flow can only be added or removed from the levee interior at breach locations. In fact the quantity of flow at cross sections 246700, 246000, and 245800 exceed the flow in the main channel of the Congaree River. The I-77 bridges constrict flow down to a maximum flow rate of 33992 cfs.

- Conclusion: Flow can only enter or exit the levee interior at a breach location. According to the Richland HEC-2 model only 33992 cfs can pass through the I-77 bridge openings in Richland County. The Richland HEC-2 model is not representative of the breach assumptions.

■ Boundary Conditions

- Flow rates behind the levee from the two models are not consistent.
 - The Richland HEC-2 model indicates a flow rate behind the levee varying between 22894 cfs to 179583 cfs. See the Table 3 above.
 - Lockwood Greene prepared independent calculations based on the geometry and head conditions of the FEMA RMA-2 northern breach (120' wide) that indicates a flow rate of 15900 cfs. The southern breach (120' wide) yielded a flow of 10400 cfs. The

combined total flow through the two breaches is 26300 cfs. See Figures 3 and 4 for rating tables of the breaches.

T a b l e 4					
Breach Location	Width	Headwater Elevation (from RMA-2)	Tailwater Elevation (from RMA-2)	Breach Bottom Elevation (from RMA-2)	Flow (cfs)
North	120'	143	135	127.6	15900
South	120'	140	135	128.2	10400
Total					26300

- It appears that the HEC-2 maximum capacity (22894 cfs) of the I-77 bridges in Richland County approximately matches the breach assumptions (26300 cfs) on the RMA-2 model.

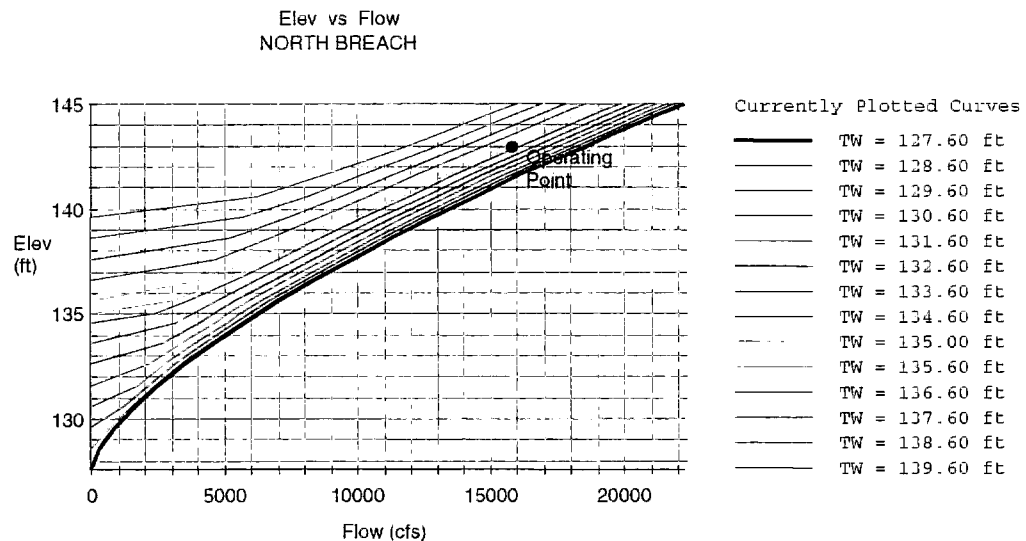


Figure 4 - North Breach Rating Curve

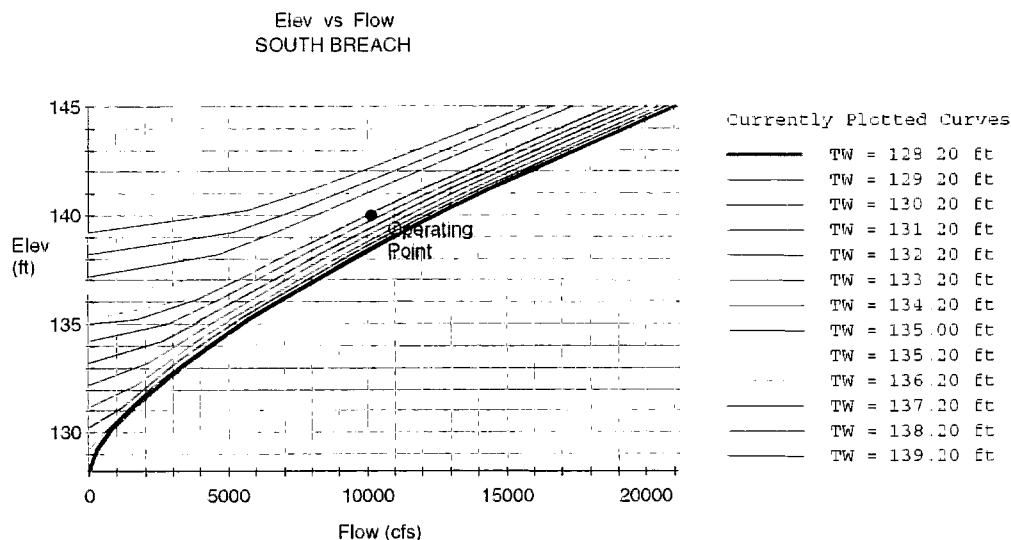


Figure 5 - South Breach Rating Curve

■ HEC-2 Summary

- FEMA should use consistent assumptions and input between the RMA-2 (2D) and HEC-2 (1D) models. Flow can only enter or exit the existing levee interior at breach locations. In the unlikely event of a double breach scenario the remaining levee will affect flow.
- Equal conveyance reduction for floodway determination is not appropriate based on RMA-2 results. The presence of the levee (even if a breach occurs) and physical constraints of the existing I-77 bridges makes equal conveyance inappropriate.
- Flow entering the levee interior is limited by two breaches and the quantity that can pass through the I-77 bridges.
- The Lexington (levee in-place) HEC-2 BFE model is the most appropriate model to establish floodway in Lexington County.

SUMMARY

- FEMA hydrology computations do not include the information provided by SCANA concerning Lake Murray and the forthcoming Lake Murray routing computations should be included in FEMA's evaluation.
- The S&ME prepared geotechnical evaluation indicates low probability of levee failure. The probability of a double breach levee failure is unlikely.
- The FEMA RMA-2 model is run as a steady state model, but the model should be run as a time varied model to obtain accurate results.
- When wet/dry boundaries are set properly ineffective flow area will increase in Richland County and calibration will become better with Lexington HEC-2 model.
- The levees around Gills Creek and the levee separating levee section 1 from 2 are missing in the RMA-2 model. If these existing levees were added it would help calibration with the Lexington (levee in scenario) HEC-2 model.
- When a flow rate of 292,000 cfs is used most of Richland County becomes ineffective flow area based on the RMA-2 model. This forces the BFE for Richland and Lexington to be equal.

Evaluation of the impact of the above on the HEC-2 model has not been made because of time constraints impose for review of the information. It is anticipate that consideration for the above items will have significant effect on the HEC-2 modeling. The effect of the above comments has been ignored in the evaluation of the HEC-2 models as present in this report and summarized below.

- Assuming the 2 breach scenario flows used in the Richland County HEC-2 model do not provide an accurate representation of the actual flows.

-
- Equal conveyance reduction is not technically appropriate for determination of the floodway because it ignores the obstruction provided by the remaining levee.
 - Lexington HEC-2 model is most appropriate to use for floodplain and floodway modeling in Lexington County.

Evaluation of the HEC-2 model is continuing and a revised Richland County model will be provided when complete.



October 25, 2000

[REDACTED]
Lockwood Greene Engineers
Post Office Box 491
Spartanburg, SC 29304

Re: Reliability of Existing Levees Against Underseepage Piping
Green Diamond Development
Columbia, SC
S&ME Project No. 1611-00-937

Dear [REDACTED]

On September 26, 2000 [REDACTED] of S&ME and [REDACTED] of Lockwood Greene discussed remarks made by a geotechnical engineer contracted by the Federal Emergency Management Authority relative to the current and proposed levee system. It was concluded that in-place permeability testing and further analysis of the existing levee system with respect to seepage, hydraulic gradient would assist in evaluating how the current levee system would respond to major flood events of the Congaree River. Of particular interest is the potential development of piping erosion below the current levee cross section, which was cited by FEMA as the most likely mode of failure.

Additional field work by S&ME incorporated in-situ hydraulic characteristic testing of the levee soils and natural base soils with hydraulic seepage analysis of critical cross sections identified by FEMA's geotechnical consultant. Accomplishment of the purpose of this investigation was achieved by the following phases of work.

1. A field program that included installing twelve piezometers at selected locations along the existing levee.
2. Field testing of the in-situ hydraulic characteristics of each of the piezometers installed.
3. Analysis of the seepage and hydraulic gradient of flow through the existing levee system based on the field data gathered, and the flood elevations provided by Lockwood Greene.

The investigation performed is intended to provide information for use in evaluating the existing levee system performance during major flood events. Our borings and tests were performed at large spacings. Though an effort was made to install piezometers and perform testing in typical soils of the levee and base material encountered during our

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original work to define as closely as reasonably possible the range of conditions present in the levee, subsurface conditions may vary somewhat between boring locations.

Levee Configuration and Profiles

S&ME was provided cross sections and survey data during our initial work. Surveyed cross sections for Levee Section 1 were performed by Surveying and Mapping, Inc. Cross sections were obtained at approximately 500-foot intervals for the entire length of both the river levee north of I-77 and the intermediate levee south of I-77. A total of 64 cross sections were surveyed. Cross section locations were marked in the field by a small plastic card on a stake with the Cross-Section number (#1A-#1D and #1 through #60) shown.

Installation and Development of Piezometers

Our field work was performed between October 3, 2000 and October 18, 2000. Field work consisted of installing piezometers and field pump tests to estimate the hydraulic conductivity of the soils within a short distance of the piezometer. S&ME performed 12 soil borings at or near locations of six previous borings drilled during our initial work. Piezometers were installed at the locations of these following previous borings, B141 (2 piezometers), B127 (1 piezometer), B126 (2 piezometers), B240 (2 piezometers), B253 (3 piezometers), and B102 (2 piezometers).

The piezometers were installed to depths ranging from approximately 6 feet to 30 feet below existing ground surface (either top of levee or base of levee). The borings were located in the field either by taping distances from existing site features or by identifying previous boring markers in the field. Figure 2 depicts the approximate locations of the borings. Elevations of the borings were estimated from previous surveys and estimates of elevations for the original boring.

Borings were drilled using a 4.25 inch I.D hollow stem auger. At each sample interval in the borings, a penetration test was performed by driving the sampler a set depth using a standard 140 pound hammer falling 30 inches in general accordance with ASTM D1586. The depth to groundwater was noted at the time of drilling. Stabilized groundwater levels in the auger borings were measured prior to performing hydraulic tests in the piezometers. Stabilized groundwater levels shown on the test boring records represent the conditions only at the time of the exploration and may fluctuate with seasonal variations in rainfall. Normally the highest seasonal groundwater levels occur in late winter and early spring and lowest levels in late summer and fall.

Piezometer completion records are presented in the Appendix . The piezometers were installed in soils ranging from natural silty sands, poorly graded sands and clays to levee silty sands and clays. Completion of piezometers consisted of placing 2 inch diameter, 0.01 inch slot, schedule 40 PVC pipe in the lower five foot of each location. Threaded two inch diameter riser pipe was then installed to above the ground surface. The slotted interval was measured and a sand pack was placed to the top of the screen as accurately

as could be measured in the field. Two piezometers encountered flowing sand such that the sand pack extended above the screened interval 1 to 2 feet as noted on the piezometer records. A minimum 1-foot bentonite seal was placed above the sand pack and hydrated to form an impermeable zone above the screened interval. The riser pipes were initially extended above ground to as near as practical the elevation of the 100 year flood.

The following table summarizes the piezometers installed, completion depths and soil types within the screened intervals.

Piezometer No.	Completion Depth Feet Below Top of Collar	Soil Type	Top of Casing Elev.
B102A	18.7 to 23.7	Natural Poorly Graded Sand	Top of Levee
B102B	3.8 to 8.8	Levee Silty Sand	Top of Levee
B126A	1.5 to 6.5	Levee Clay	Top of Levee
B126B	0.9 to 5.9	Natural Clay	Base of Levee
B127A	17.1 to 22.1	Natural Silty Sand	Top of Levee
B141A	5.2 to 10.2	Levee Silty Sand	Top of Levee
B141B	17.4 to 22.4	Natural Silty Sand	Top of Levee
B240A	4.5 to 9.5	Levee Clay	Top of Levee
B240B	23.2 to 28.2	Natural Poorly Graded Sand	Top of Levee
B253A	21.6 to 26.6	Natural Poorly Graded Sand with Silt	Top of Levee
B253B	12.9 to 17.9	Natural Silty Sand	Top of Levee
B253C	3.9 to 8.9	Levee Clay	Top of Levee

Following completion of the testing the piezometer will be abandoned by pulling readily removable pipe and filling all voids with bentonite chips.

Field Permeability Testing

Prior to hydraulic characteristic testing in each piezometer the depth of the ground water was measured. Four piezometers encountered groundwater, B102A, B240B, B253A, B253B, and could thus be considered as fully saturated tests. The remaining 8 piezometers were dry and required inundation of the surrounding soils to a saturated or near saturated state prior to performing either falling head or constant head tests. Both falling head and constant head permeability tests were conducted in each piezometer to check the findings of either approach. Typically, five to six tests were performed to establish repeatable values and allow statistical treatment of the results.

Due to the variability of the soils and the current moisture content of the soils the amount of water added to each piezometer to achieve consistent hydraulic readings varied significantly. The following table summarizes each piezometer, the quantity of water added and the type of test performed.

Piezometer No.	Soil Type	Type of Test	Quantity of Water
B126A	Levee Clay	Constant Head, Unsaturated	75 Liters
B240A	Levee Clay	Constant Head, Unsaturated	44 Liters
B253C	Levee Clay	Constant Head Unsaturated	33 Liters
B126B	Natural Clay	Constant Head Unsaturated	118 Liters
B102B	Levee Silty Sand	Constant Head Unsaturated	130 Liters
B141A	Levee Silty Sand	Constant Head Unsaturated	550 Liters
B127A	Natural Silty Sand	Falling Head Unsaturated	945 Liters
B141B	Natural Silty Sand	Falling Head Unsaturated	1340 Liters
B253B	Natural Silty Sand	Falling Head Saturated	1010 Liters
B253A	Natural Poorly Graded Sand with Silt	Falling Head Saturated	1020 Liters
B102A	Natural Poorly Graded Sand	Falling Head Saturated	1260 Liters
B240B	Natural Poorly Graded Sand	Falling Head Saturated	1970 Liters

Constant head tests in unsaturated soils were modeled using the van Genuchten model regression analysis approach described by Daniel B. Stephens, Kevin Lambert, and David Watkins in Water Resources Research Bull. Vol. 23, No. 12, pp. 2207-2214 (Dec. 1987) to estimate the saturated hydraulic conductivity of the unsaturated soils. Falling head tests in unsaturated soils after inundation and in saturated soils were modeled using the procedure described in Figure 13 of volume 7.1 of the US Navy Facilities Engineering Command Design Manual (page 7.1-104) for a piezometer in isotropic soil.

Laboratory Testing

A limited laboratory testing program was performed to supplement earlier tests. These included grain size analysis and Atterberg limits to allow correlation of the piezometer completion depths to samples obtained during the original investigations. Laboratory test results are presented in Appendix D on the laboratory summary table.

Soil Permeability Values

The following table summarizes the in-situ permeability tests.

Piezometer No.	Soil Type	Permeability Range Feet/Seconds	Expected Value Feet/Second	Standard Deviation
B126A	Levee Clay	$7.5 \times 10^{-6} - 4.5 \times 10^{-6}$	6.0×10^{-6}	1.5×10^{-6}
B240A	Levee Clay	$7.0 \times 10^{-8} - 1.1 \times 10^{-8}$	9.2×10^{-8}	2.3×10^{-8}
B253C	Levee Clay	$4.5 \times 10^{-7} - 2.7 \times 10^{-7}$	3.6×10^{-7}	8.8×10^{-8}
B126B	Natural Clay	$1.7 \times 10^{-5} - 1.0 \times 10^{-5}$	1.4×10^{-5}	3.3×10^{-6}
B102B	Levee Silty Sand	$8.7 \times 10^{-6} - 5.3 \times 10^{-6}$	7.0×10^{-6}	1.7×10^{-6}
B141A	Levee Silty Sand	$4.9 \times 10^{-5} - 2.9 \times 10^{-5}$	3.9×10^{-5}	9.6×10^{-5}
B127A	Natural Silty Sand	$3.8 \times 10^{-3} - 1.3 \times 10^{-3}$	6.9×10^{-3}	1.1×10^{-2}
B141B	Natural Silty Sand	$6.5 \times 10^{-5} - 3.1 \times 10^{-5}$	4.9×10^{-5}	3.6×10^{-5}
B253B	Natural Silty Sand	$2.0 \times 10^{-4} - 1.6 \times 10^{-4}$	1.8×10^{-4}	1.3×10^{-4}
B253A	Natural Poorly Graded Sand with Silt	$1.1 \times 10^{-4} - 1.3 \times 10^{-4}$	1.2×10^{-4}	5.6×10^{-5}
B102A	Natural Poorly Graded Sand	$9.9 \times 10^{-5} - 7.4 \times 10^{-5}$	8.7×10^{-5}	7.1×10^{-5}
B240B	Natural Poorly Graded Sand	$2.7 \times 10^{-4} - 2.0 \times 10^{-4}$	2.2×10^{-4}	1.1×10^{-4}

Probability of Piping Occurrence

There is no specific requirement described in 44CFR 65.10 for protection against uplift pressures and piping. Excess seepage pressures and resultant piping failure is described in the literature as having an order of magnitude greater probability of occurrence than slope instability for short term conditions. Formation of seepage boils and subsequent piping of soils from the landside toe of the levee is described as the most likely mode of levee failure in 1976.

If uplift pressures in pervious deposits underlying impervious or semipervious top strata landward of the levee exceed the effective weight of the top stratum, heaving or rupturing of the top strata could result in formation of sand boils or piping below the levee foundation. An estimate of substratum pressures was made at selected cross sections along Levee 1 and the intermediate levee at locations where soil conditions were reasonably well defined by soil test borings conducted during earlier exploration. The equations used were those presented in Appendix B of US Army Corps of Engineers Engineering Manual 1110-2-1913, "Design and Construction of Levees" (April, 2000), which were in turn developed during a study (reported in U.S. Army Engineer Waterways Experiment Station TM 3-424 (Appendix A) of piezometric data and seepage measurements along the Lower Mississippi River and confirmed by model studies.

Under this approach the foundation is generalized into a pervious sand or gravel stratum with a uniform thickness and permeability and a semipervious or impervious top stratum with a uniform thickness and permeability (although the thickness and permeability of the riverside and landside top stratum may be different). This approach involves certain other simplifying assumptions:

- Seepage may enter the pervious substratum at any point in the foreshore (usually at riverside borrowpits) and/or through the riverside top stratum.

- Flow through the top stratum is vertical.
- Flow through the pervious substratum is horizontal.
- The levee (including impervious or thick berms) and the portion of the top stratum beneath it is impervious.
- All seepage is laminar.

The typical levee cross section analyzed is illustrated in Figure 3 in the Appendix. For this analyses, we assumed the top strata both landside and riverside of the levee to be semipervious. We assumed an open seepage entrance on the riverside at a distance from the levee equal to the distance to the river channel. A blocked seepage exit landward of the levee (due to a cutoff of the pervious layer by buried silt or clay deposits or by landward thickening of the top stratum) was assumed at a distance of 20 feet landward of the landside toe. This seepage geometry is given as Case VII in Appendix B of EM 1110-2-1913 referenced above.

The exit gradient landside of the levee, defined as the excess hydrostatic head at the landside toe divided by the thickness of the top stratum, was used to define the performance of the levee against piping occurrence. The value of the critical hydrostatic gradient for piping occurrence was assumed to be 1.0, based on an in-situ top stratum buoyant unit weight approximately equating to the unit weight of water. All levee cross sections were assumed to be dry, that is, no ponded water on the landside toe except in drainage ditches where these lie close to the levee.

For an existing levee subjected to a flood, the probability of piping failure can be expressed as a function of the floodwater elevation and other factors including soil permeability, embankment geometry, foundation stratigraphy, etc. This analysis focused on developing the *conditional* probability of failure function for the floodwater elevation, constructed using engineering estimates of the probability functions or moments of the relevant variables. This approach is described in US Army Corps of Engineers Technical Letter 1110-2-556 (1999).

Five random variables were considered. These included the horizontal permeability of the pervious substratum k_r , the vertical permeability of the semi-pervious top blanket k_r on the riverside, and the vertical permeability k_l on the landside. Permeability values were assumed to have a coefficient of variability of 30 percent. As there is some uncertainty regarding the thicknesses of the soil strata between boring locations, the thickness of the pervious strata (d) and the top elevation of the pervious strata landward of the levee were also modeled as random variables. Their deviations are set to match engineering judgment regarding the probable range of actual values. Assigning a standard deviation to the top elevation of the pervious layer of 2.5 ft models a high probability that the actual value lies between two consecutive split spoon samples in the borings. The thickness of the pervious layer was assumed to have a coefficient of variability of 50 percent.

To facilitate computation, a spreadsheet was developed that accomplishes the following for each stage of flooding at each input cross section:

- Solves for the exit gradient using the methods in EM 1110-2-1913 Appendix B.
- Repeats the solution for 11 combinations of the input parameters required in the Taylor's series method.
- Determines the expected value and standard deviation of the exit gradient.
- Calculates the expected value and standard deviation of the natural logarithm of the exit gradient.
- Calculates the probability that the exit gradient is above the critical value of 1.0 required to initiate boiling or piping.

Results from the spreadsheet for Cross Section 16 for a river stage of 140 feet are shown on the following page. The details of the calculations follow.

For the first analysis (Run 1), the random variables are all taken at their expected values. From EM 1110-2-1913, first the effective exit distance x_3 is calculated as:

$$X_3 = 1 / C \times \tanh (CL_3), \text{ where:}$$

$$C = \{k_{bl} / (k_f \times z_{bl} \times d)\}^{0.5}$$

L_3 = distance from the landside levee toe to an effective seepage block in the pervious layer

k_{bl} = permeability of top strata landward of the levee toe

k_f = permeability of pervious stratum

z_{bl} = thickness of top strata landward of the levee toe

d = thickness of pervious stratum

RIVER STAGE 140 FEET CROSS SECTION 16
 TAYLORS SERIES EXPANSION FOR LEVEE UNDERSEEPAGE
 CASE VII-PARTIALLY PERMEABLE SEEPAGE BERMS ON BOTH RIVER AND LAND SIDES
 WITH SEEPAGE BLOCK 20 FEET FROM LANDSIDE TOE

Kbl	Kbr	Kf	d	z	zbr	zbl	cr	cl	X1	X3	Ho	ho/Zbl	var comp	% of var
0.000020	0.000197	0.000591	20	110.00	19.00	15.00	0.0296	0.0105	33	457	12.28	0.82		
0.000014	0.000197	0.000591	20	110.00	19.00	15.00	0.0296	0.0088	33	650	12.98	0.87		
2.559E-05	0.000197	0.000591	20	110.00	19.00	15.00	0.0296	0.0120	33	353	11.65	0.78	0.0019425	8.53
0.000020	0.000138	0.000591	20	110.00	19.00	15.00	0.0248	0.0105	39	457	12.15	0.81		
0.000020	0.0002559	0.000591	20	110.00	19.00	15.00	0.0338	0.0105	29	457	12.36	0.82	4.83E-05	0.21
0.000020	0.000197	0.000413	20	110.00	19.00	15.00	0.0354	0.0126	28	322	11.55	0.77		
0.000020	0.000197	0.0007677	20	110.00	19.00	15.00	0.0260	0.0092	37	592	12.73	0.85	0.0015574	6.84
0.000020	0.000197	0.000591	10	110.00	19.00	15.00	0.0419	0.0149	24	232	10.74	0.72		
0.000020	0.000197	0.000591	30	110.00	19.00	15.00	0.0242	0.0086	40	682	12.95	0.86	0.0054453	23.92
0.000020	0.000197	0.000591	20	107.50	21.50	17.50	0.0278	0.0098	35	532	12.56	0.72		
0.000020	0.000197	0.000591	20	112.50	16.50	12.50	0.0318	0.0115	31	382	11.91	0.95	0.0137666	60.49
sum													0.0227601	100

crest elev	142 ft
elev of toe (inside)	125 ft
elev of toe (outside)	129 ft
crest width	11 ft
inside slope	1.6 H:V
outside slope	2.3 H:V
dist to river channel	L1 80 ft
dist to seepage block	L3 20 ft
Width of Levee at base	L2 68.1 ft
Tailwater Elevation	0 ft
	averag Coeff var std dev avg+std dev - std dev
Substratum Permeability ft/sec	3 E-04 30 9.E-05 4.E-04 2.E-04
Top Blanket Permeability (outside)	1 E-04 30 3.E-05 1.E-04 7.E-05
Top Blanket Permeability (inside)	1.E-05 30 3.E-06 1.E-05 7.E-06
Thickness of Pervious Layer	20 50 10 30.0 10.0
Top elev of pervious	110 2.27 2.5 112.5 107.5

E(I)	0.82	E(InI)	-0.21702
Var(I)	0.0228		
sig(I)	0.1509	sig(InI)	0.1827869
Vx	0.1843		
z	0.75		
normsdist	0.7732		
prob > crit	0.2268		

The distance from the landside toe to the effective source of seepage entrance X_1 is:

$$X_1 = \tanh CL_1 / C, \text{ where:}$$

L_1 = distance from the landside levee toe to the river from topo map.

The net residual head under the top stratum at the levee toe h_0 is:

$$h_0 = H \{ X_3 / (X_1 + L_2 + X_3) \}, \text{ where:}$$

H = total head above the landside levee toe to the flood elevation

L_2 = base width of the levee, determined by the levee crest elevation, width, and side slopes obtained from surveyed cross sections.

And the landside toe exit gradient i is:

$$i = h_0 / z_b$$

For subsequent runs, the variables are in turn adjusted to their expected values plus and minus one standard deviation, holding the other variables at their expected values. These are used to determine the component of the total variance related to the variation of each variable. When the variance components are summed in the spreadsheet above, the total variance of the exit gradient is 0.0227. Taking the square root of the variance gives the standard deviation of 0.151.

The exit gradient was assumed to be a lognormally distributed random variable with probabilistic moments $E[i] = 0.82$ and $\sigma_i = 0.151$. Using the properties of the lognormal distribution, the equivalent normally distributed random variable has moments $E[\ln i] = -0.217$ and $\sigma_{\ln i} = .183$.

The critical exit gradient is assumed to be 1.0. The probability of failure is then.

$$P_{rf} = P_r (\ln i > \ln 1.0)$$

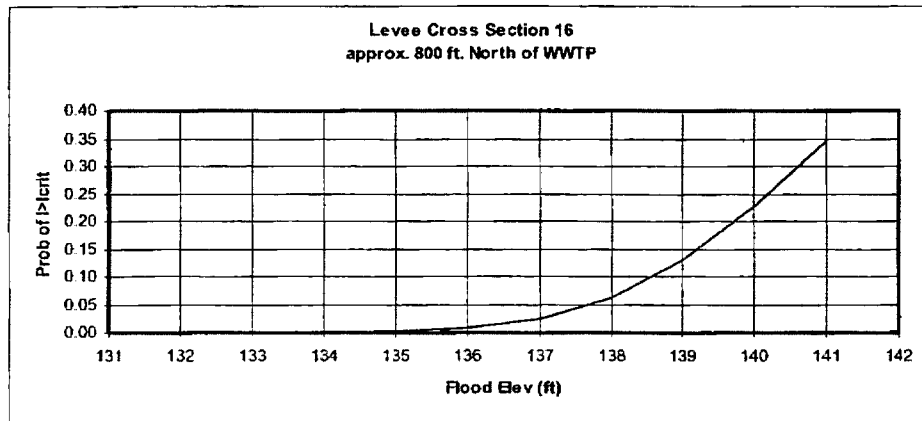
This probability was evaluated using a normal distribution function built into the Microsoft Excel spreadsheet. It can be solved using standard tables by first calculating the standard normalized variate z :

$$z = (\ln i_{crit} - E(\ln i)) / \sigma_{\ln i}$$

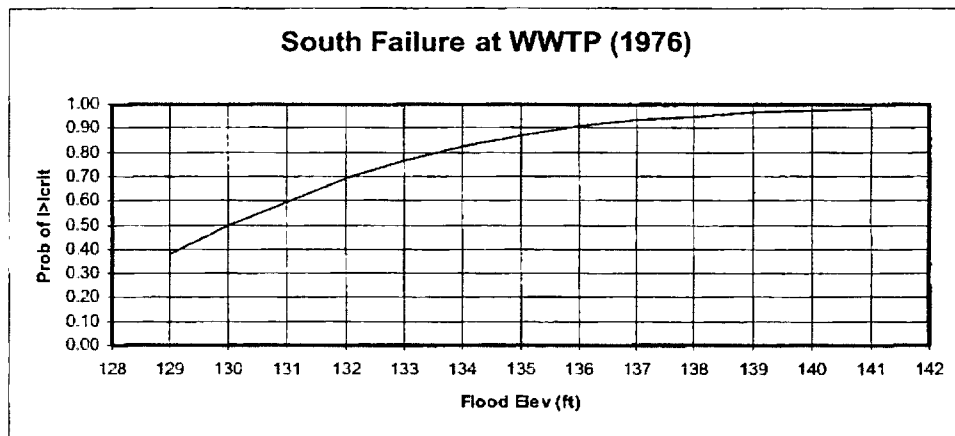
For the moment values given above, the standard normalized variate is 0.75. For this value, the cumulative distribution function (NORMSDIST) is 0.773, and represents the probability that the exit gradient is below the critical gradient of 1.0. The probability that the exit gradient exceeds the critical gradient is

$$P_{rf} = 1 - \text{NORMSDIST}(z) = 1 - 0.773 = 0.227, \text{ or } 22.7 \text{ percent}$$

The analysis was repeated for a range of flood stages up to the crest elevation. The resulting conditional probability of failure function was plotted as shown below for Levee Cross Section 16. The shape of the probability of failure function is similar to that suggested in ETL 1110-2-556 for "good" levees in that the probability of failure is very low until the flood stage on the levee exceeds about 139 ft, after which it curves up sharply. When the floodwater elevation is near the top of the levee, the conditional probability of failure approaches 35 percent.



To compare the remaining sections of the Manning Levee to locations where failure of the levee is known to have previously occurred, the analysis described above was performed for the geometry of the 1976 South Failure at the City of Columbia Wastewater Treatment Plant. Expected values and variabilities for permeability of the top strata and pervious strata were assigned to soil types described in the 1976 borings using the pump test data described in the preceding chapters. The conditional probability of failure function for this cross section is given below:



The shape of the probability of failure function here is similar to that described in ETL 1110-2-556 for a "poor" levee. The probability of failure function is concave upwards for flood elevations considerably below the crest elevation at that location (140 feet). Failure of the levee was noted to have occurred at flood elevation 134.9 feet. At that flood stage the probability of the exit gradient at the toe exceeding the critical value was approximately 85 percent.

Levee probability of failure by cross section was determined for three different flood stages and are tabulated below. The relative flood elevation at each cross section during each event was estimated from the profile of flood elevations shown on a drawing titled "Levee Profile, Levee Sections One and Two" dated August 19, 1999 by Lockwood Greene Engineers.

- The first stage considered was the 1976 event which resulted in failure at the City of Columbia Wastewater Treatment Plant at an flood elevation of 134.9 feet at the plant. Backwater in Gills Creek was estimated to be at approximately 130 feet and there was no water in Levee Section 2, so that the intermediate levee between Sections 1 and 2 was not subject to any head.
- Next we considered a flood approximating the 100 year BFE computed by Lockwood Greene for a 252,000 cfs flow. In this case Levee Section 2 was assumed flooded to elevation 134.4 feet along with Gills Creek.
- The final run considered a flood approximately 2 feet higher than the 100 year BFE profile shown on the Lockwood Greene plan of 1999, approximating the 2000 FEMA 100-year BFE for 292,000 cfs flow. At this point the flood elevation approaches the levee crest just north of the wastewater plant. Thus this would be the maximum elevation where piping would be the most likely mode of failure. The pool downstream of the intermediate levee south of I-77 is approximately 138 feet and the intermediate levee between Levee Section 1 and Section 2 has been overtopped.

Location	Cross Section	1976 Flood		100 Year BFE by Lockwood Greene 252,000 cfs		100 Year BFE by FEMA 292,000 cfs	
		Flood Elev.	P _{ff} %	Flood Elev.	P _{ff} %	Flood Elev.	P _{ff} %
North End of Main Levee	1A	138.0	0.0	141.1	2.0	142.0	4.0
Gregg Property	3	137.5	<1.0	141.5	5.0	142.0	10.0
Gregg Property	6	137.2	0.0	140.0	0.0	142.0	0.0
Columbia Venture	11	136.3	4.0	140.1	16.0	142.0	32.0
Heathwood Hall	13	136.0	1.0	139.2	12.0	141.2	28.0
Heathwood Hall	15	135.7	3.0	138.9	10.0	140.9	18.0
Heathwood Hall	16	135.5	1.0	138.5	10.0	140.5	28.0
City WWTP	WWTP	134.9	85.0	-	-	-	-
South Trib. Levee	30	No water	-	134.4	0.0	138	0.0
South Trib. Levee	36	No water	-	134.4	21.0	138	Overtop
South Trib. Levee	38	No water	-	134.4	18.0	138	Overtop
South Trib. Levee	41	No water	-	134.4	14.0	138	Overtop
Gills Creek	48	130.0	<1.0	134.4	16.0	138	Overtop

Conclusions

The above data suggest that the levee north of the wastewater treatment plant provides generally good reliability against development of excessive seepage exit gradients on the landside toe up to the 292,000 cfs 100-year base flood. At no cross section analyzed does the probability of failure approach the 85 percent value determined for the 1976 South Failure.

There is about a 1/3 probability of piping development at the worst location evaluated between cross sections 11 and the boundary of the wastewater treatment plant at flood levels slightly below the minimum crest elevation in that section. These estimates are likely conservative because we considered the protected area behind the levee to be dry up to the point of failure – that is, there is no ponded water landward of the levee due to internal drainage. A breach at any one location – either due to piping or overtopping – would result in ponding landward of the remaining levee, decreasing the net head across each section and decreasing the exit gradient, thus stabilizing the remaining sections.

One of the conveyance formulations presented in the FEMA presentation was based on formation of two breaches in the portion of Levee Section 1 north of the wastewater treatment plant. These breaches were simulated in the FEMA finite element analyses by removing a portion of the levee at locations corresponding roughly to cross sections 1A and 15. To evaluate the probability of breaches occurring in both locations during a single flood, we first defined the reliability of the levee reach defined by cross sections 1A through 6 and the reach defined by cross sections 11 through the WWTP to be the products of the individual reliabilities of the 3 to 4 cross sections analyzed for seepage gradient in each reach. Reliability is defined as unity minus the probability of failure. The joint probability of at least one breach occurring at any location, in both reaches at the same flood stage, is thus $\{1 - (1 - P_{rf1A})(1 - P_{rf3})(1 - P_{rf6})\}$ times $\{1 - (1 - P_{rf11})(1 - P_{rf13})(1 - P_{rf15})(1 - P_{rf16})\}$, or approximately 9 percent for the FEMA 100-year BFE.

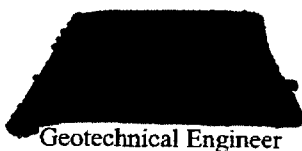
The 9 percent probability of two breaches occurring does not take into account the reduced potential for piping occurrence in the event that a tailwater condition exists landward of the levee once a breach has occurred. Reduction in net head across the levee due to ponding on the landside would greatly reduce the exit gradient and potential for formation of seepage erosion channels. If a breach formed on the levee near the wastewater plant and water were to pond behind levee cross sections 1A through 6 to a depth of 3 to 5 feet (to elevation 130), for example, the probability of a second breach forming at the north end of the protected area would be reduced to about 2 percent.

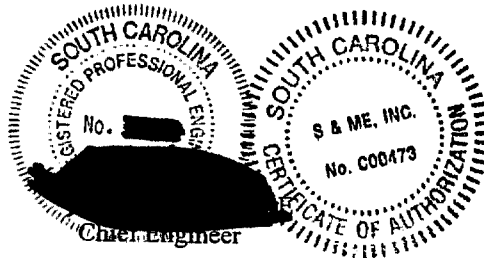
The reliability analysis above suggests a low probability of two widely separated breaches forming in the Manning Levee where it fronts the Congaree River during the 100 year BFE. While two breaches were observed in the City of Columbia levee in 1976, we feel that the second breach, which formed at a penetration, was due to poor backfilling around the conduit when the treatment plant was built about 1970. The reliability of the existing levee will be further improved by raising the crest and reshaping the side slopes, which will increase the length of the seepage path and further reduce the exit gradients.

Please call if you have any questions.

Very Truly Yours,

S&ME, Inc.

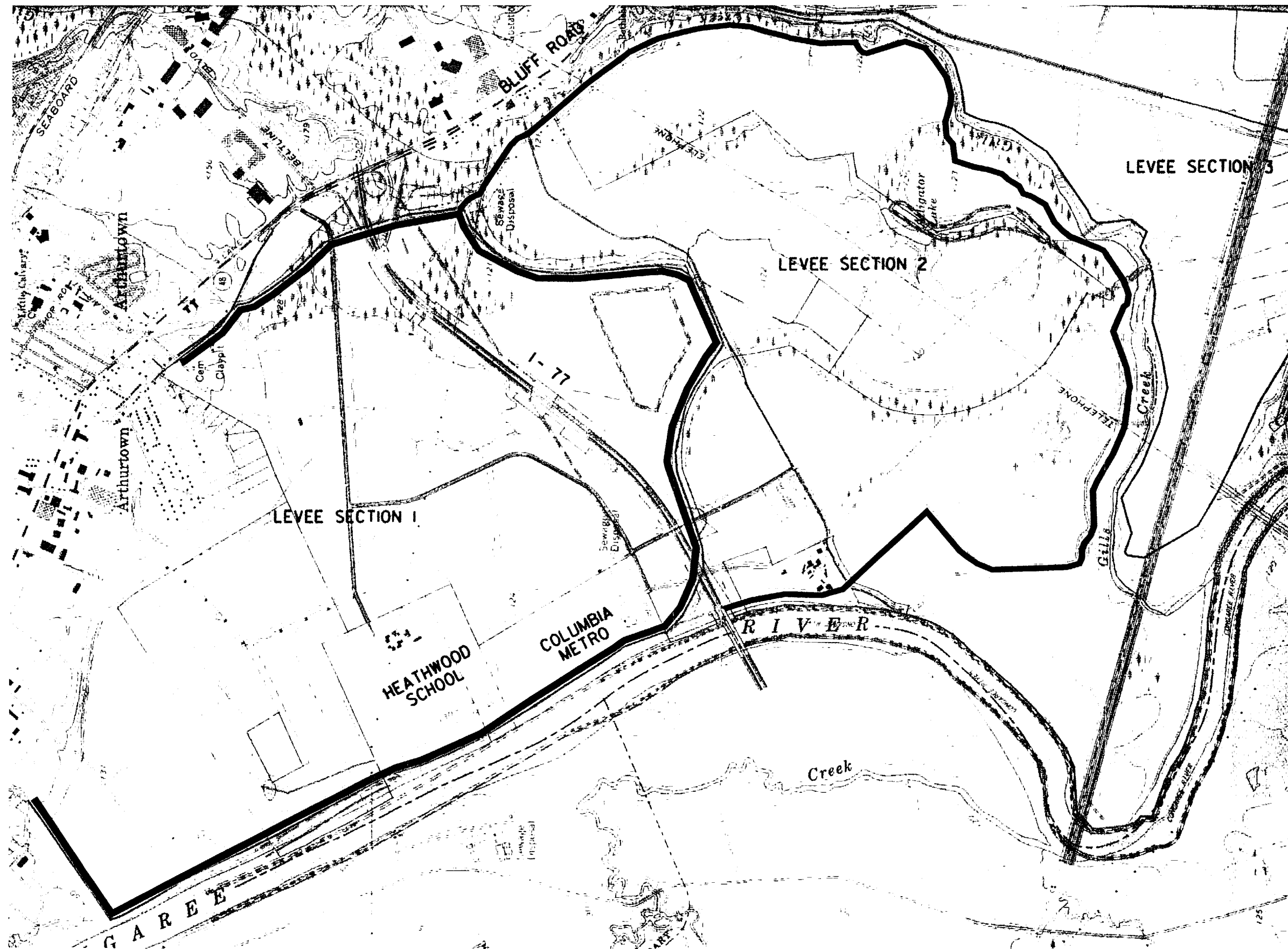

Geotechnical Engineer



Attachments:

- Appendix A – Figures
- Appendix B – Boring Logs
- Appendix C – Piezometer Logs
- Appendix D – Laboratory Exhibit Sheets
- Appendix E – Seepage Computation Spreadsheet Input Pages

APPENDIX A



SCALE: 1"=2000'

CHECKED BY:

DRAWN BY: JWB

DATE: 10-24-00



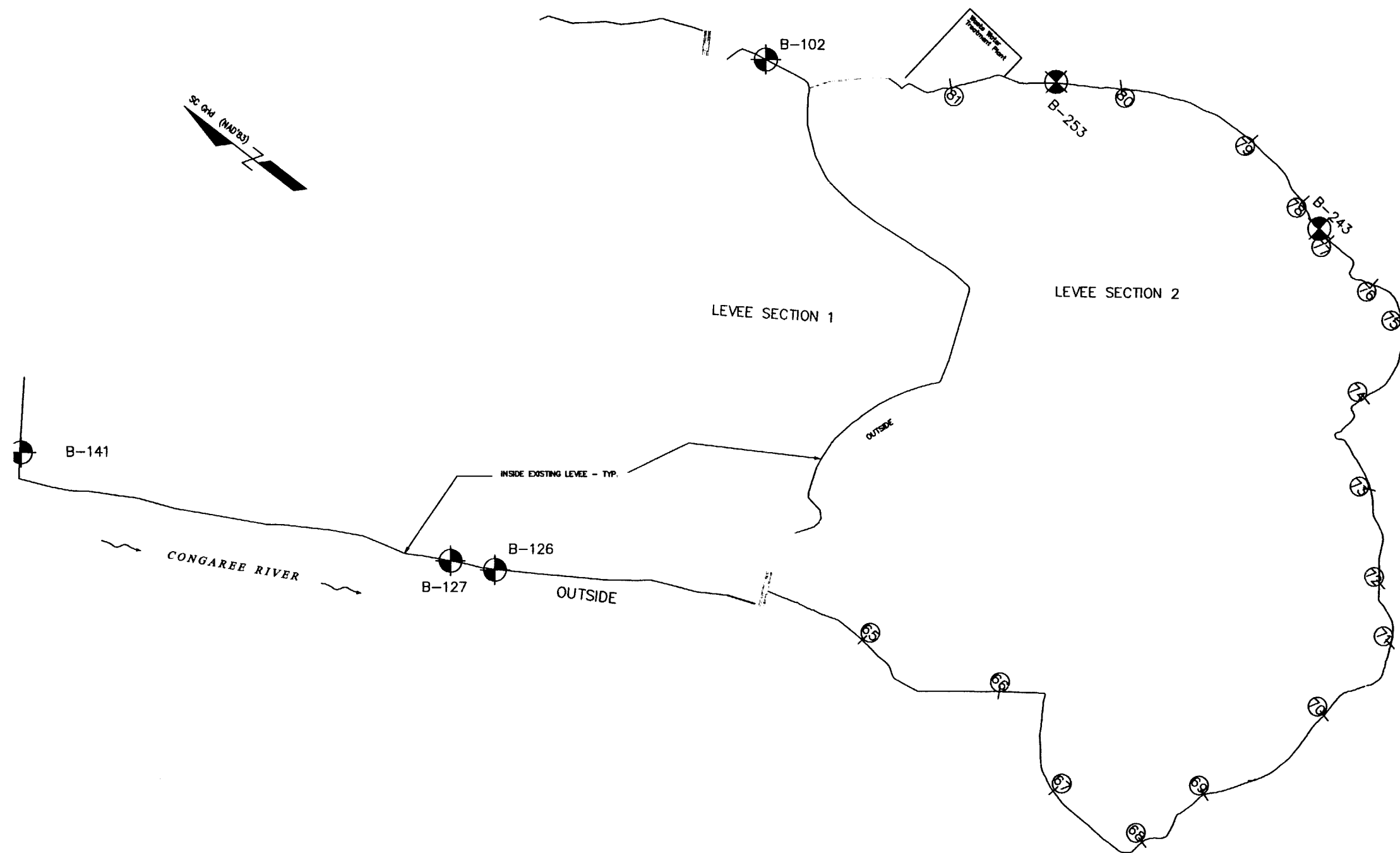
SITE LOCATION MAP
CONGAREE LEVEES

COLUMBIA, SC

JOB NO: 1611-00-937

FIGURE NO:

1



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JWB
DATE:	10-24-00



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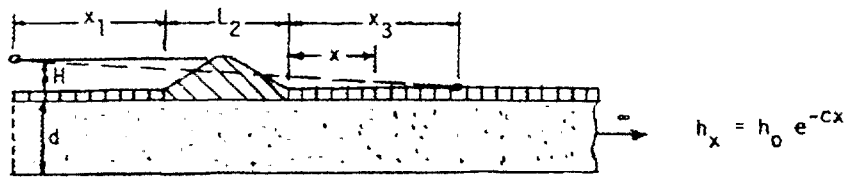
BORING LOCATION PLAN
CONGAREE LEVEE
RICHLAND COUNTY

JOB NO: 1611-00-937

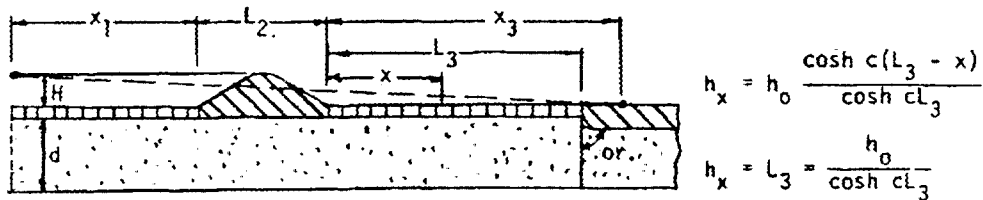
FIGURE NO:

2

31 Mar 78

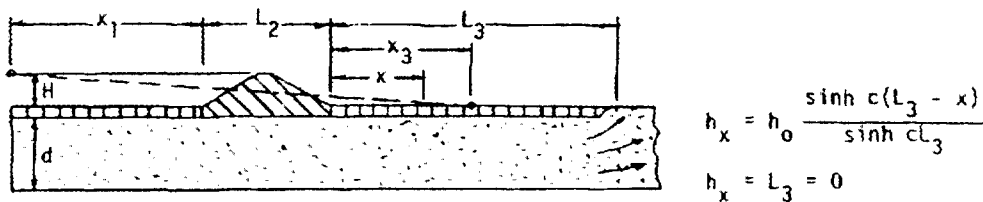
a. $L_3 = \infty$

$$h_x = h_0 e^{-cx}$$

b. L_3 is finite to a seepage block

$$h_x = h_0 \frac{\cosh c(L_3 - x)}{\cosh cL_3}$$

$$h_x = L_3 = \frac{h_0}{\cosh cL_3}$$

c. L_3 is finite to an open seepage exit

$$h_x = h_0 \frac{\sinh c(L_3 - x)}{\sinh cL_3}$$

$$h_x = L_3 = 0$$

BASIC DEFINITIONS AND EQUATIONS

SEEPAGE PER UNIT LENGTH OF LEVEE $Q_s = \int k_f H = \frac{dk_f H}{x_1 + L_2 + x_3}$

HEAD BENEATH TOP STRATUM AT LANDSIDE LEVEE TOE $h_0 = \frac{Hx_3}{x_1 + L_2 + x_3}$

THE FACTOR $c = \sqrt{\frac{k_{BL}}{k_f z_{BL} d}}$

Lockwood Greene Engineers
Spartanburg, South Carolina



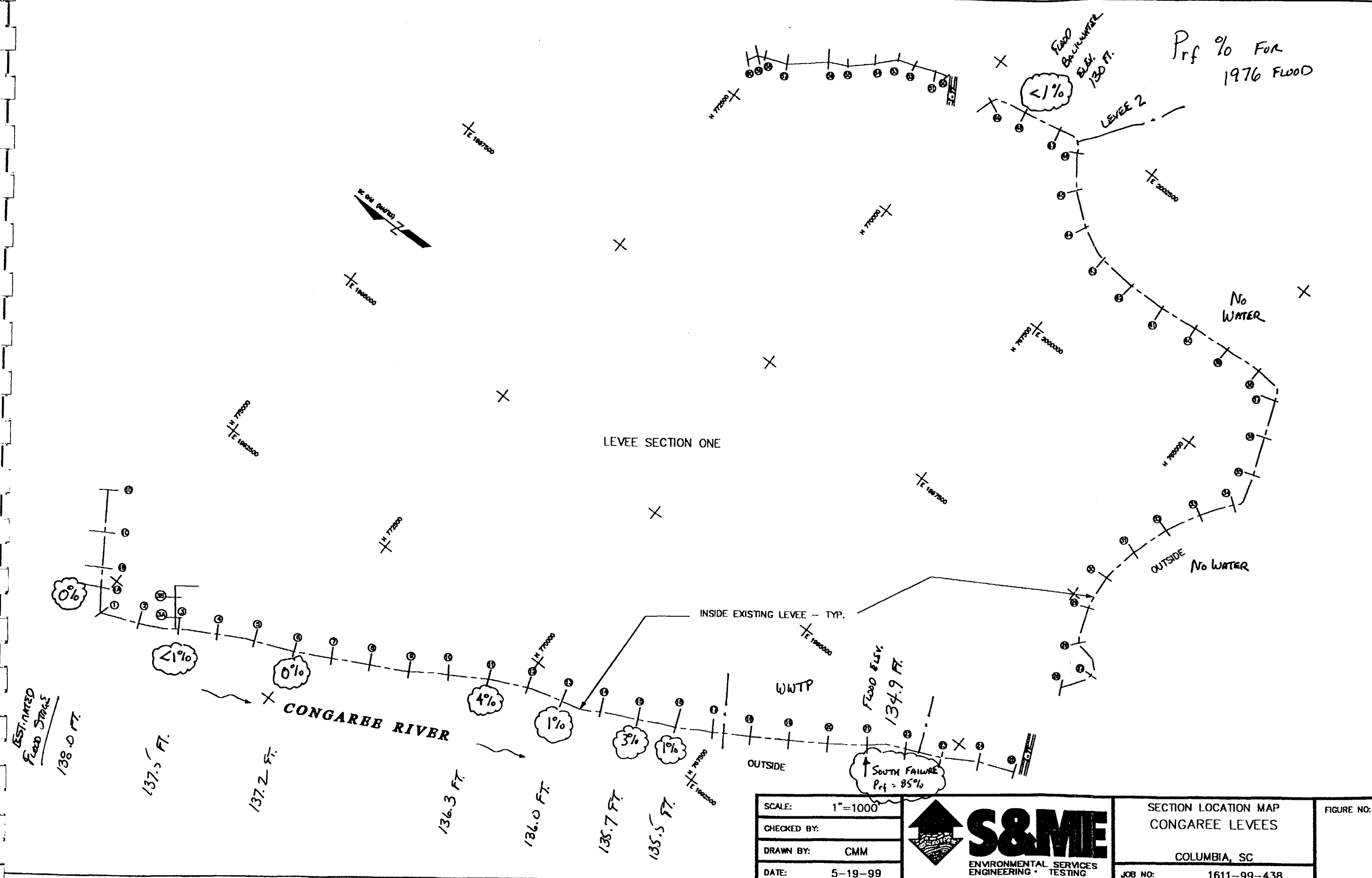
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Equations for Computation of
Underseepage and Substratum
Pressures for Case 7

SCALE NTS DATE 10/25/00 DRAWN BY JCL CHECKED BY JCL

JOB NO 1611-00-937

FIGURE NO
3

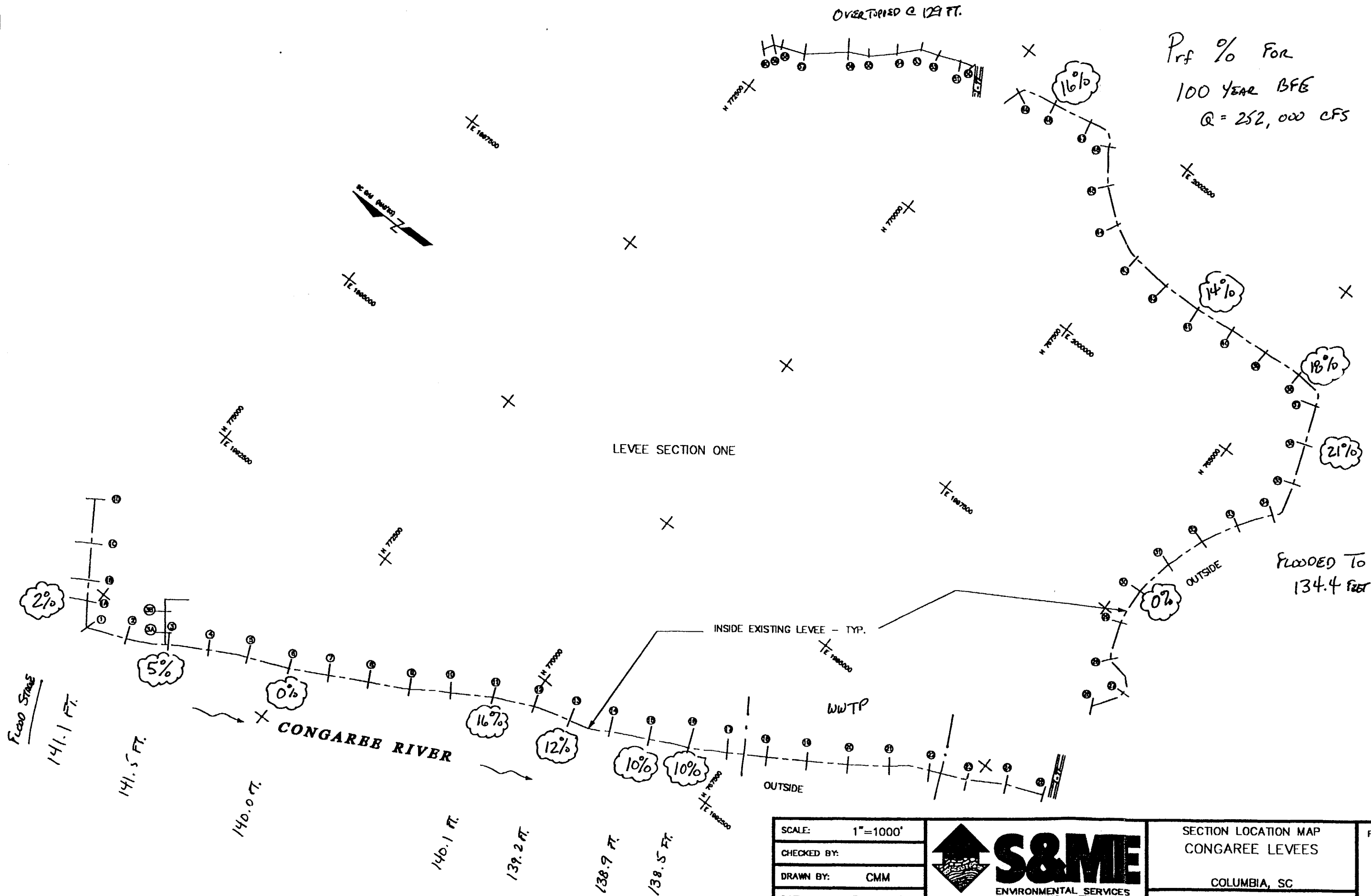


SCALE:	1"=1000
CHECKED BY:	
DRAWN BY:	CMM
DATE:	5-19-99



SECTION LOCATION MAP CONGAREE LEVEES
COLUMBIA, SC
JOB NO: 1611-99-438

FIGURE NO:



Prf % For
100 YEAR BFE
Q = 252,000 CFS

LEVEE SECTION ONE

INSIDE EXISTING LEVEE - TYP.

WWTTP

FLOODED TO
134.4 FEET

SCALE:	1"=1000'
CHECKED BY:	
DRAWN BY:	CMM
DATE:	5-19-99



SECTION LOCATION MAP CONGARREE LEVEES
COLUMBIA, SC
JOB NO: 1611-99-438

FIGURE NO:

APPENDIX B

PROJECT: Congaree Levee Columbia, South Carolina 1611-00-937				BORING LOG B102A			
DATE DRILLED: 10/5/00		ELEVATION: 136.0		NOTES:			
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 23.7					
LOGGED BY: JWB		WATER LEVEL: 13 feet at time of boring, 17.75 feet on 10/17/00.					
DRILLER: Raleigh		DRILL RIG: ATV					

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)	N VALUE
						10 20 30 60 80	
5	[Symbol]	SILTY SAND (SM) - mostly fine sands, some low plasticity fines 20-30%, brown, slightly moist, micaceous - top of pipe even with ground surface, total pipe length 23.67 feet, 1.4 feet of sand filled in pipe from flowing sand.		131.0	7		7
10				126.0			
15		- bentonite seal to 12 feet. Moist to very moist. POORLY GRADED SANDS (SP) - mostly fine to medium sands, brown, wet.	▽	121.0			
20		- sand pack to 17.5 feet, sand flowed into auger. - top of screen at 18.67 feet	▽	116.0			
		- sand filled screen to 22 feet 3 inches -200 = 2.6% - screen set 18.67 feet to 23.67 feet Boring terminated at 23.7 feet.					

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT



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Columbia, SC 29210

BURNING LOG 00-3314 GPJ STATE BUT 10/23/00

-



Page 1 of 1

PROJECT: Congaree Levee Columbia, South Carolina 1611-00-937				BORING LOG B126A			
DATE DRILLED: 10/3/00		ELEVATION: 140.0		NOTES: Top of Levee near section 15.			
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 9.0					
LOGGED BY: JWB		WATER LEVEL: Dry at time of boring. Dry on 10/12/00.					
DRILLER: Raleigh		DRILL RIG: ATV					
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)	
						10 20 30 60 80	
		LEAN CLAY WITH SAND (CL) - mostly low to medium plasticity fines, some fine sands, brown, moist, micaceous. - bentonite seal to 0.1 foot, top of pipe 4 1/2 inches above ground, total length of pipe 6 feet 10 inches. - sand pack to 1.5 feet, top of screen					
5		-200 = 80%, MC = 17.9%, LL = 46, PI = 20. - screen set 1.5 feet to 6.5 feet		135.0	1	17	
		SILTY SAND (SM) - mostly fine sands, some low plasticity fines, light brown, moist, micaceous.			2	14	
		Boring terminated at 9 feet Offset boring, drilled to 6.5 foot to install screen					

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586
 2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.



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PROJECT: Congaree Levee Columbia, South Carolina 1611-00-937			BORING LOG B127A			
DATE DRILLED: 10/3/00		ELEVATION: 144.0		NOTES: Top of Levee.		
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 21.1				
LOGGED BY: JWB		WATER LEVEL: Dry at time of boring. Dry on 10/13/00.				
DRILLER: Raleigh		DRILL RIG: ATV				

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)	N VALUE
		SANDY LEAN CLAY (CL) - mostly low to medium plasticity fines, some fine sands 35-50%, brown, moist, micaceous. - top of pipe 5 1/2 inches above ground surface, total length of pipe 21 feet 6 inches.				10 20 30 60 80	
5		SILTY SAND (SM) - mostly fine sands, some low plasticity fines, reddish brown, slightly moist, micaceous, commonly grades to silty sand. (Fill)		139.0	1		13
10				134.0			
15		SILTY SAND (SM) - mostly fine sands, some low plasticity fines, light brown, slightly moist to dry micaceous. - bentonite seal to 12.8 feet - at 16 feet decrease in fines content, micaceous. - sand pack to 16.05 feet, top of screen		129.0			
20		-200 = 36%, MC = 7.5% - screen set 16.05 feet to 21.05 feet Boring terminated at 21.05 feet		124.0	2		21

- 1 BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586
- 2 PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT



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134 Suber Road
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PROJECT Congaree Levee Columbia, South Carolina 1611-00-937				BORING LOG B141A							
DATE DRILLED: 10/3/00		ELEVATION: 148.0		NOTES Approximately 460 feet along north levee from corner, Section 1A.							
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 10.2									
LOGGED BY: JWB		WATER LEVEL: Dry at time of boring. Dry on 10/18/00.									
DRILLER: Raleigh		DRILL RIG: ATV									
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO./TYPE	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						10	20	30	60	80	
5		SILTY SAND (SM)- mostly fine sand, some low plasticity fines, brown, slightly moist, micaceous. - top of pipe flush with ground surface total length of pipe 10 feet 2 inches. - bentonite seal to 2 feet 3 inches. - sand pack to 5 2 feet, top of screen		143.0							
10		-200 = 17.5%, MC = 4.8% - screen set at 5 2 feet to 10 2 feet Boring terminated at 10 2 feet		138.0	1	●					10

- 1 BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586
 2 PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1 1/4 IN. I.D. SAMPLER 1 FT.



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PROJECT: Congaree Levee Columbia, South Carolina 1611-00-937				BORING LOG B141B			
DATE DRILLED: 10/3/00		ELEVATION: 148.0		NOTES:			
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 23.0					
LOGGED BY: JWB		WATER LEVEL: Dry at time of boring. Dry on 10/13/00.					
DRILLER: Raleigh		DRILL RIG: ATV					
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)	N VALUE
		SILTY SAND (SM) - mostly fine sand, some low plasticity fines, brown, slightly moist, micaceous. - top of pipe 1/4 inch below ground surface, total length of pipe 22 feet 4 3/4 inches.				10 20 30 60 80	
5				143.0			
10				138.0			
15		- bentonite seal to 13 feet 5 inches.		133.0			
20		- sand pack to 17.4 feet, top of screen.		128.0			
		-200 = 17.0%, MC = 9.4% - screen set at 17.4 feet to 22.4 feet.			1	●	17
		Boring terminated at 23 feet					

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.



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PROJECT: Congaree Levee Columbia, South Carolina 1611-00-937				BORING LOG B240A			
DATE DRILLED: 10/4/00		ELEVATION: 134.0		NOTES:			
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 9.5					
LOGGED BY: JWB		WATER LEVEL: Dry at time of boring. Dry on 10/16/00.					
DRILLER: Raleigh		DRILL RIG: ATV					

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)	N VALUE
						10 20 30 60 80	
		LEAN CLAY (CL) - mostly low to medium plasticity fines, some fine sands 15-25%, moist to slightly moist, grades to silt commonly, occasional silty sand lenses. - top of pipe 1/4 inch below ground surface, total length of pipe 9 feet 6 1/2 inches - bentonite seal to 2.8 feet - sand pack to 4.5 feet, top of screen -200 = 87, MC = 19.9, LL = 41, PI = 16 - screen set 4.5 feet to 9.5 feet Boring terminated at 9.5 feet		129.0			

- 1 BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586
- 2 PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.



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134 Suber Road
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PROJECT: Congaree Levee Columbia, South Carolina 1611-00-937				BORING LOG B240B			
DATE DRILLED: 10/4/00		ELEVATION: 134.0		NOTES:			
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 28.2					
LOGGED BY: JWB		WATER LEVEL: 21 feet at time of boring, 18.1 feet on 10/16/00.					
DRILLER: Raleigh		DRILL RIG: ATV					

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						10	20	30	60	80	
5		LEAN CLAY WITH SAND (CL) - mostly low to medium plasticity fines, some fine sands, brown, slightly moist to moist, micaceous - top of pipe 1 foot 10 inches above ground surface, total length of pipe 30 feet		129.0							
10											
15											
20											
		- bentonite seal to 16 feet 7 inches.	▼								
25		POORLY GRADED SAND (SP) - fine sands, visual classification from cuttings - sand pack to 21.9 feet, sand flowed into auger, 2 1/2 bags sand added for pack - top of screen.		114.0							
		- screen set 23.2 feet to 28.2 feet Boring terminated at 28.2 feet	▽								
				109.0							

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT



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PROJECT: Congaree Levee Columbia, South Carolina 1611-00-937			BORING LOG B253A								
DATE DRILLED: 10/5/00		ELEVATION: 132.0			NOTES:						
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 26.6									
LOGGED BY: JWB		WATER LEVEL: 11.5 feet at time of boring, 14.3 feet on 10/14/00.									
DRILLER: Raleigh		DRILL RIG: ATV									
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						10	20	30	60	80	
5		LEAN CLAY WITH SAND (CL) - mostly low to medium plasticity fines, some fine sands 20-30%, slightly moist, micaceous. - top of pipe 3 feet 1/4 inch above ground surface, total length of pipe 29 6 feet - bentonite seal to 8 feet 11 inches.	▽	127.0							
10			▽	122.0							
15		SILTY SAND (SM) - mostly fine sands, some low plasticity fines 20-35%.	▽	117.0							
20		POORLY GRADED SANDS (SP) - fine to medium sands, gray, grades to POORLY GRADED SAND WITH SILT - sand pack to 19 feet, sand flowed into auger 1 bag added for pack. - top of screen. -200 = 10%. MC = 34.2%	▽	112.0							
25		- screen set 21 6 feet to 26 6 feet. Boring terminated at 26 6 feet.		107.0							

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1 4 IN I.D. SAMPLER 1 FT



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PROJECT: Congaree Levee Columbia, South Carolina 1611-00-937				BORING LOG B253B			
DATE DRILLED: 10/5/00		ELEVATION: 132.0		NOTES:			
DRILLING METHOD: 4 1/4" H.S.A.		BORING DEPTH: 17.9					
LOGGED BY: JWB		WATER LEVEL: 11.5 feet at time of boring, 14 feet on 10/14/00.					
DRILLER: Raleigh		DRILL RIG: ATV					

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)					N VALUE
						10	20	30	60	80	
5		LEAN CLAY WITH SAND (CL) - mostly low to medium plasticity fines, some fine sands 20-30% slightly moist, micaceous. - top of pipe 2 feet 3 3/4 inches above ground surface, total pipe length 20 feet 2 3/4 inches		127.0							
10		- bentonite seal to 7 feet 11 inches		122.0							
15		SILTY SAND (SM) - mostly fine sands, some low plasticity fines 20-30%. - sand pack to 12.9 feet, top of screen	▽								
17		-200 = 17%. - screen set 12.9 feet to 17.9 feet Boring Terminated at 17.9 feet	▼	117.0							

- 1 BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
- 2 PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.



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- 1 BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586
2 PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB HAMMER
FALLING 30 IN. REQUIRED TO DRIVE 1 IN I.D. SAMPLER 1 FT.



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APPENDIX C

COMPLETION REPORT OF WELL No. B102A

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL: 13 feet at time of boring,
17.75 feet on 10/17/00.

DRILLING CONTRACTOR:

DRILLING METHOD: 4 1/4" H.S.A.

DATE DRILLED: 10/5/00

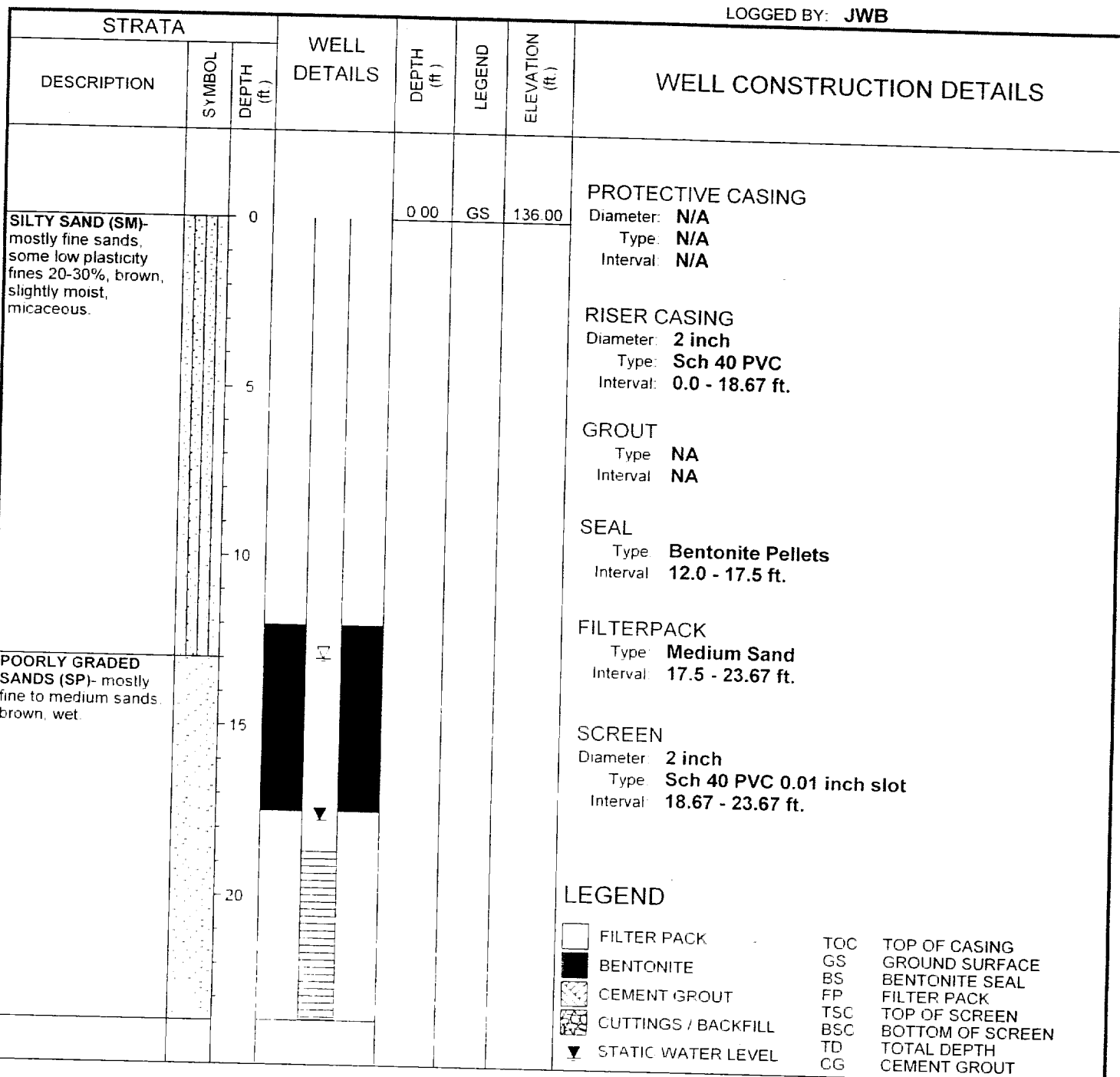
LATITUDE

LONGITUDE

TOP OF CASING ELEVATION: 136.00

DATUM: MSL

LOGGED BY: JWB



134 Suber Road
Columbia, SC 29210

COMPLETION REPORT OF
WELL No. B102A

Sheet 1 of 1

COMPLETION REPORT OF WELL No. B102B

Sheet 1 of 1

PROJECT: **Congaree Levee**
 PROJECT NO: **1611-00-937**
 PROJECT LOCATION: **Columbia, South Carolina**

WATER LEVEL **Dry at time of boring. Dry on 10/6/00.**

DRILLING CONTRACTOR:

LATITUDE:

DRILLING METHOD: **4 1/4" H.S.A.**

LONGITUDE:

DATE DRILLED: **10/5/00**

TOP OF CASING ELEVATION: **137.10**

DATUM: **MSL**

LOGGED BY: **JWB**

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
SILTY SAND (SM)- mostly fine sands, some low plasticity fines 20-30%, brown, slightly moist, micaceous.		0		0.00	GS	136.00	PROTECTIVE CASING Diameter: N/A Type: N/A Interval: N/A
		5					RISER CASING Diameter: 2 inch Type: Sch 40 PVC Interval: -1.1 - 3.8 ft.
							GROUT Type: NA Interval: NA
							SEAL Type: Bentonite Pellets Interval: 2 - 3.8 ft.
							FILTERPACK Type: Medium Sand Interval: 3.8 - 8.8 ft.
							SCREEN Diameter: 2 inch Type: Sch 40 PVC 0.01 inch slot Interval: 3.8 - 8.8 ft.
LEGEND							
	FILTER PACK			BENTONITE		TOC	TOP OF CASING
	CEMENT GROUT			CUTTINGS / BACKFILL		GS	GROUND SURFACE
	STATIC WATER LEVEL					BS	BENTONITE SEAL
						FP	FILTER PACK
						TSC	TOP OF SCREEN
						BSC	BOTTOM OF SCREEN
						TD	TOTAL DEPTH
						CG	CEMENT GROUT



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COMPLETION REPORT OF
 WELL No. B102B

Sheet 1 of 1

COMPLETION REPORT OF WELL No. B126A

Sheet 1 of 1

PROJECT: **Congaree Levee**
 PROJECT NO: **1611-00-937**
 PROJECT LOCATION: **Columbia, South Carolina**

WATER LEVEL: **Dry at time of boring. Dry on 10/12/00.**

DRILLING CONTRACTOR:

LATITUDE:

LONGITUDE:

DRILLING METHOD: **4 1/4" H.S.A.**

TOP OF CASING ELEVATION **140.40**

DATE DRILLED: **10/3/00**

DATUM **MSL**

LOGGED BY **JWB**

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
LEAN CLAY WITH SAND (CL)- mostly low to medium plasticity fines, some fine sands, brown, moist, micaceous		0		0.00	GS	140.00	PROTECTIVE CASING Diameter N/A Type N/A Interval N/A RISER CASING Diameter 2 inch Type Sch 40 PVC Interval -0.4 - 1.5 ft. GROUT Type NA Interval NA SEAL Type Bentonite Pellets Interval 0.1 - 1.5 ft. FILTERPACK Type Medium Sand Interval 1.5 - 6.5 ft.
SILTY SAND (SM)- mostly fine sands, some low plasticity fines, light brown, moist, micaceous		5					SCREEN Diameter 2 inch Type Sch 40 PVC 0.01 inch slot Interval 1.5 - 6.5 ft. LEGEND <div> FILTER PACK BENTONITE CEMENT GROUT CUTTINGS / BACKFILL STATIC WATER LEVEL </div> <div> TOC TOP OF CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN TD TOTAL DEPTH CG CEMENT GROUT </div>



134 Suber Road
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COMPLETION REPORT OF
 WELL No. B126A

Sheet 1 of 1

MONITORING WELL 00-937A-GPJ-SC-ME-GDT-10/25/00

COMPLETION REPORT OF WELL No. B126B

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL 7.5 feet at time of boring, Dry on 10/12/00.

DRILLING CONTRACTOR:

LATITUDE

LONGITUDE

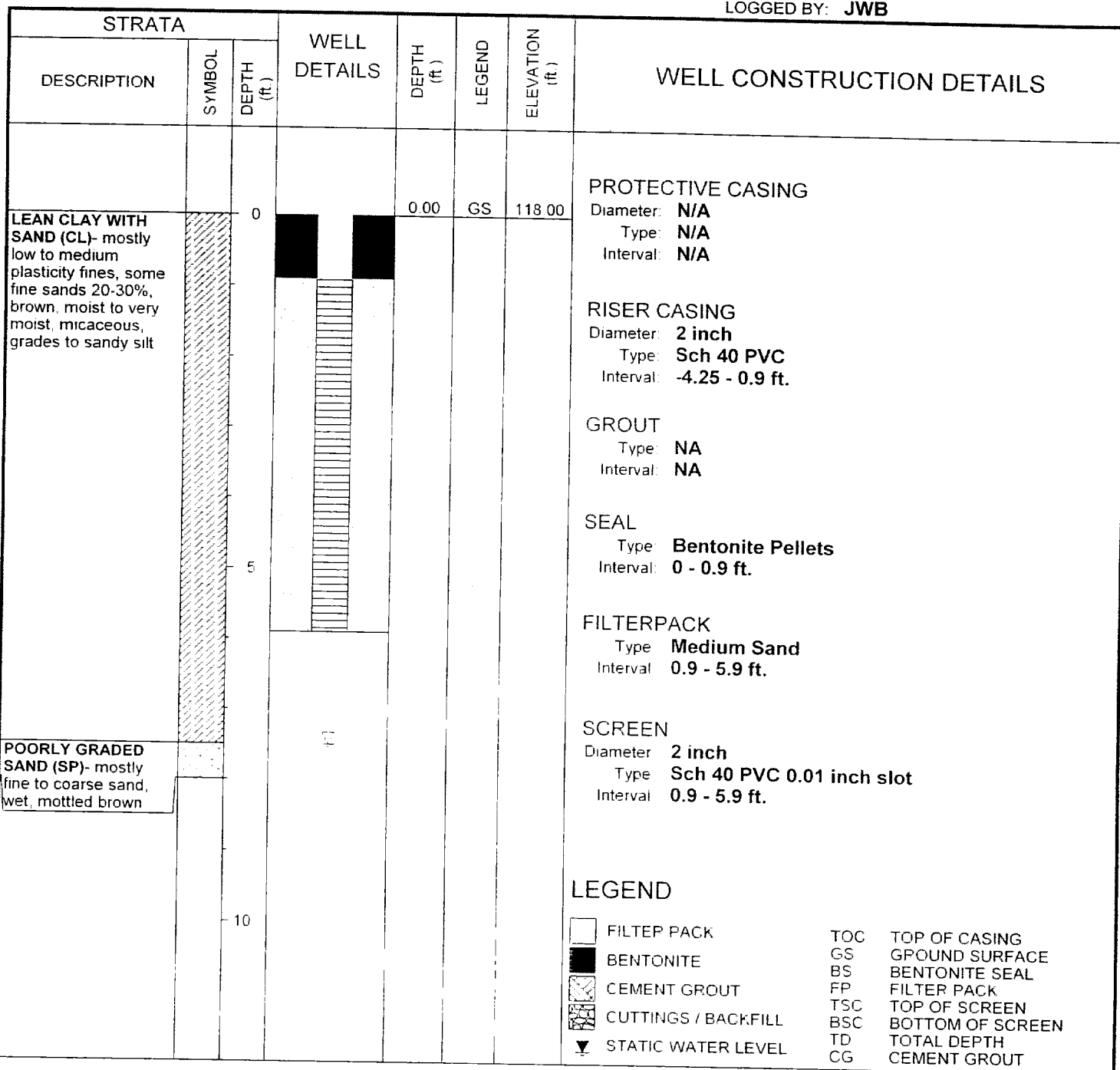
DRILLING METHOD: 4 1/4" H.S.A.

TOP OF CASING ELEVATION 122.30

DATE DRILLED: 10/4/00

DATUM: MSL

LOGGED BY: JWB



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COMPLETION REPORT OF
WELL No. B126B

Sheet 1 of 1

MONITORING WELL 00-037A G.P.J. S&ME G.O.T. 10/25/00

COMPLETION REPORT OF WELL No. B127A

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL Dry at time of boring. Dry on 10/13/00.

DRILLING CONTRACTOR:

DRILLING METHOD: 4 1/4" H.S.A.

DATE DRILLED: 10/3/00


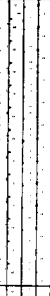






LATITUDE

LONGITUDE

TOP OF CASING ELEVATION: 144.50

DATUM: MSL

LOGGED BY: JWB

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
SANDY LEAN CLAY (CL)- mostly low to medium plasticity fines, some fine sands 35-50%, brown, moist, micaceous.		0				144.00	PROTECTIVE CASING Diameter: N/A Type: N/A Interval: N/A
SILTY SAND (SM)- mostly fine sands, some low plasticity fines, reddish brown, slightly moist, micaceous, commonly grades to silty sand (Fill)		5					RISER CASING Diameter: 2 inch Type: Sch 40 PVC Interval: -.5 - 16.05 ft.
SILTY SAND (SM)- mostly fine sands, some low plasticity fines, light brown, slightly moist to dry micaceous.		10					GROUT Type: NA Interval: NA
		15					SEAL Type: Bentonite Pellets Interval: 12.8 - 16.05 ft.
		20					FILTERPACK Type: Medium Sand Interval: 16.05 - 21.05 ft.
							SCREEN Diameter: 2 inch Type: Sch 40 PVC 0.01 inch slot Interval: 16.05 - 21.05 ft.
LEGEND							
	FILTER PACK						TOC TOP OF CASING
	BENTONITE						GS GROUND SURFACE
	CEMENT GROUT						BS BENTONITE SEAL
	CUTTINGS / BACKFILL						FP FILTER PACK
	STATIC WATER LEVEL						TSC TOP OF SCREEN
							BSC BOTTOM OF SCREEN
							TD TOTAL DEPTH
							CG CEMENT GROUT



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COMPLETION REPORT OF
WELL No. B127A

Sheet 1 of 1

MONITORING WELL 10-937A GPJ S&ME GDT 10/25/00

COMPLETION REPORT OF WELL No. B141A

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL: Dry at time of boring. Dry on 10/18/00.

DRILLING CONTRACTOR

DRILLING METHOD 4 1/4" H.S.A.

DATE DRILLED 10/3/00

LATITUDE:

LONGITUDE:

TOP OF CASING ELEVATION: 148.00

DATUM: MSL

LOGGED BY: JWB

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
SILTY SAND (SM)- mostly fine sand, some low plasticity fines, brown, slightly moist, micaceous.		0		0.00	GS	148.00	PROTECTIVE CASING Diameter: N/A Type: N/A Interval: N/A
		5					RISER CASING Diameter: 2 inch Type: Sch 40 PVC Interval: 0 - 5.2 ft.
		10					GROUT Type: NA Interval: NA
							SEAL Type: Bentonite Pellets Interval: 2.3 - 5.2 ft.
							FILTERPACK Type: Medium Sand Interval: 5.2 - 10.2 ft.
							SCREEN Diameter: 2 inch Type: Sch 40 PVC 0.01 inch slot Interval: 5.2 - 10.2 ft.
LEGEND							
<div> <div></div> FILTER PACK <div></div> BENTONITE <div></div> CEMENT GROUT <div></div> CUTTINGS / BACKFILL <div></div> STATIC WATER LEVEL </div>							TOC TOP OF CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN TD TOTAL DEPTH CG CEMENT GROUT

MONITORING WELL 00-937A G.P.J. S&ME GDT 10/25/00



134 Suber Road
Columbia, SC 29210

COMPLETION REPORT OF
WELL No. B141A

Sheet 1 of 1

COMPLETION REPORT OF WELL No. B141B

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL: Dry at time of boring. Dry on 10/13/00.

DRILLING CONTRACTOR:

LATITUDE:

DRILLING METHOD: 4 1/4" H.S.A.

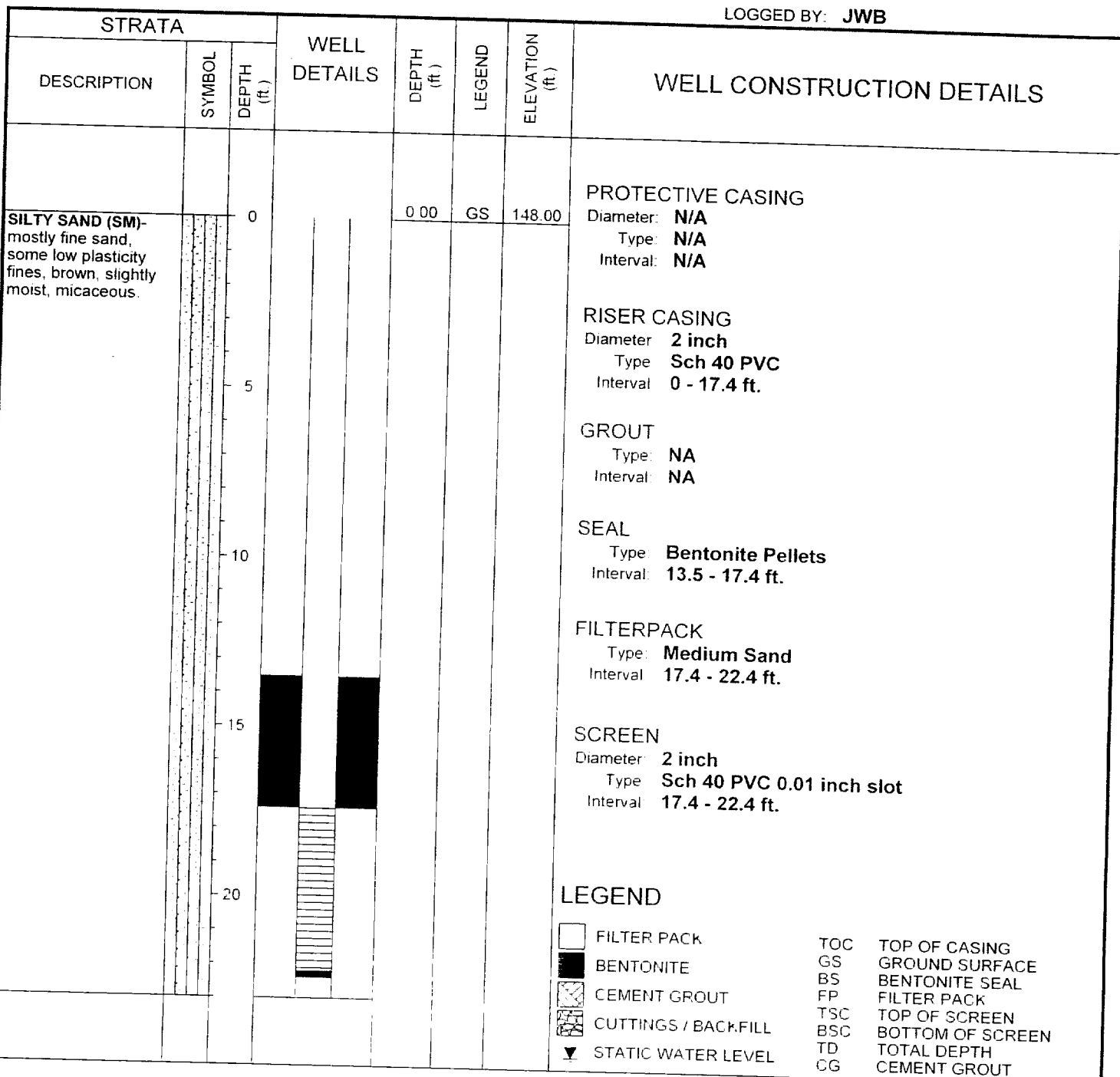
LONGITUDE:

DATE DRILLED: 10/3/00

TOP OF CASING ELEVATION: 148.00

DATUM: MSL

LOGGED BY: JWB



134 Suber Road
Columbia, SC 29210

COMPLETION REPORT OF
WELL No. B141B

Sheet 1 of 1

NOTHING WELL 00-037A GPJ S&ME GDT 10/25/00

COMPLETION REPORT OF WELL No. B240A

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL: Dry at time of boring. Dry on 10/16/00.

DRILLING CONTRACTOR

DRILLING METHOD 4 1/4" H.S.A.

DATE DRILLED 10/4/00







LATITUDE:

LONGITUDE:

TOP OF CASING ELEVATION: 134.00

DATUM: MSL

LOGGED BY: JWB

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
LEAN CLAY (CL)- mostly low to medium plasticity fines, some fine sands 15-25%, moist to slightly moist, grades to silt commonly, occasional silty sand lenses		0		0.00	GS	134.00	<p>PROTECTIVE CASING Diameter N/A Type N/A Interval N/A</p> <p>RISER CASING Diameter 2 inch Type Sch 40 PVC Interval 0 - 4.5 ft.</p> <p>GROUT Type NA Interval NA</p> <p>SEAL Type Bentonite Pellets Interval 2.8 - 4.5 ft.</p> <p>FILTERPACK Type Medium Sand Interval 4.5 - 9.5 ft.</p> <p>SCREEN Diameter 2 inch Type Sch 40 PVC 0.01 inch slot Interval 4.5 - 9.5 ft.</p> <p>LEGEND</p> <div>  FILTER PACK  BENTONITE  CEMENT GROUT  CUTTINGS / BACKFILL  STATIC WATER LEVEL </div> <div> <p>TOC TOP OF CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN TD TOTAL DEPTH CG CEMENT GROUT</p> </div>



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Columbia, SC 29210

COMPLETION REPORT OF
WELL No. B240A

Sheet 1 of 1

MONITORING WELL 00-337A-GPJ S&ME GDT 10/25/00

COMPLETION REPORT OF WELL No. B240B

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL 21 feet at time of boring, 18.1 feet on 10/16/00.

DRILLING CONTRACTOR:

LATITUDE:

LONGITUDE:

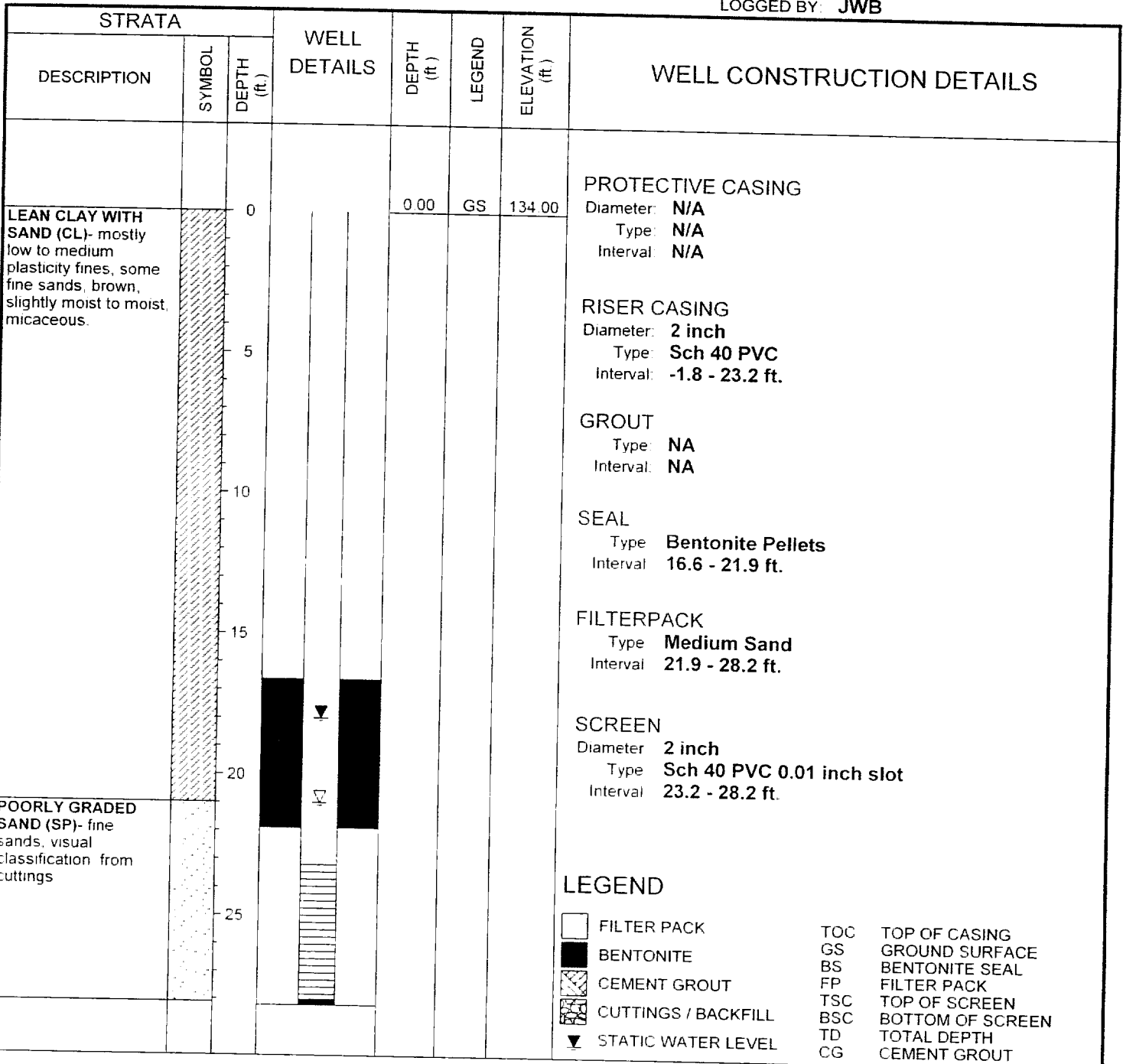
DRILLING METHOD: 4 1/4" H.S.A.

TOP OF CASING ELEVATION: 135.80

DATE DRILLED: 10/4/00

DATUM: MSL

LOGGED BY: JWB



134 Suber Road
Columbia, SC 29210

COMPLETION REPORT OF
WELL No. B240B

Sheet 1 of 1

COMPLETION REPORT OF WELL No. B253A

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL 11.5 feet at time of boring,
14.3 feet on 10/14/00.

DRILLING CONTRACTOR:

LATITUDE

LONGITUDE:

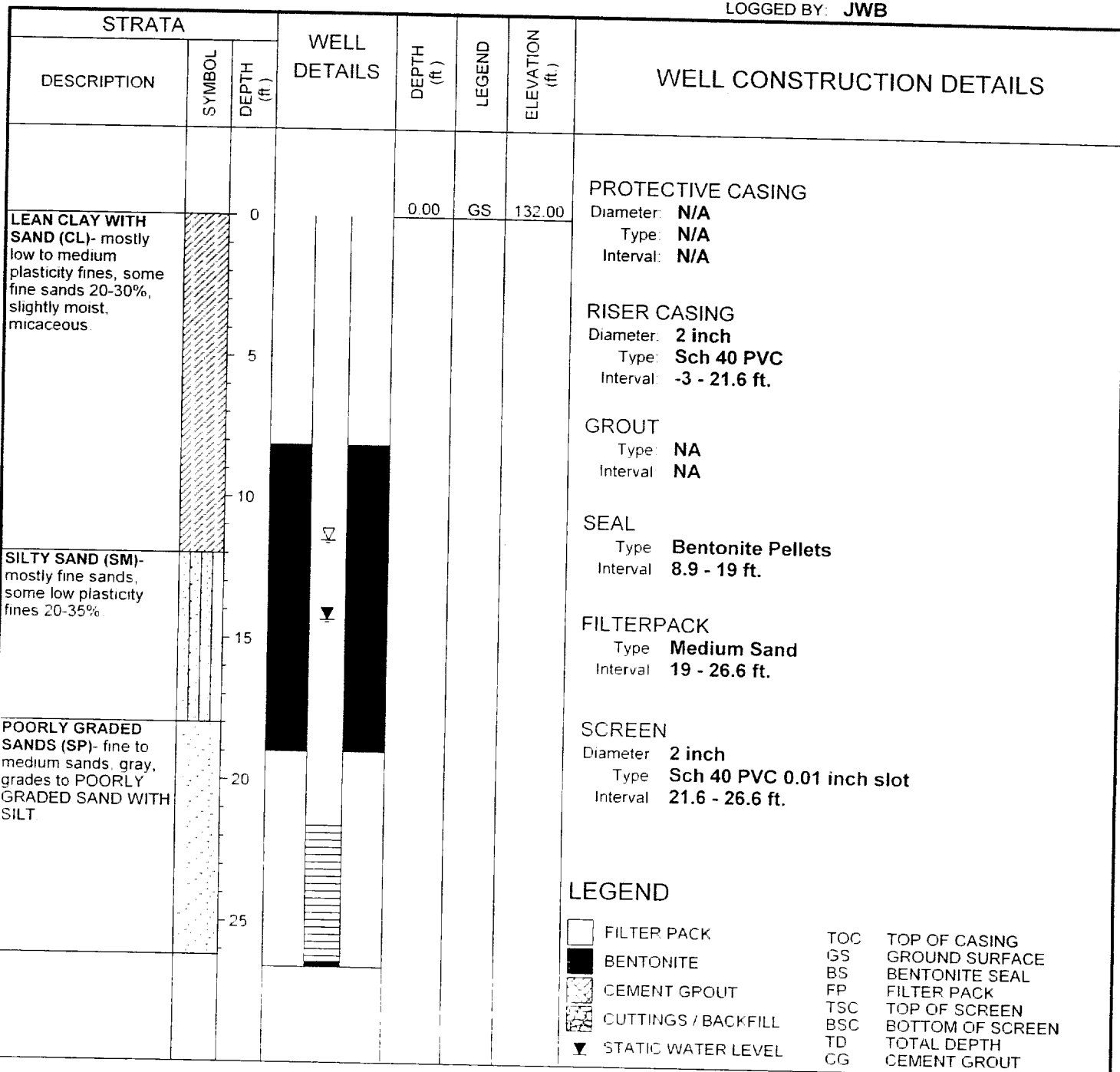
DRILLING METHOD: 4 1/4" H.S.A.

TOP OF CASING ELEVATION: 135.00

DATE DRILLED: 10/5/00

DATUM: MSL

LOGGED BY: JWB



134 Suber Road
Columbia, SC 29210

COMPLETION REPORT OF
WELL No. B253A

Sheet 1 of 1

COMPLETION REPORT OF WELL No. B253B

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL: 11.5 feet at time of boring, 14 feet on 10/14/00.

DRILLING CONTRACTOR:

DRILLING METHOD: 4 1/4" H.S.A.

DATE DRILLED: 10/5/00

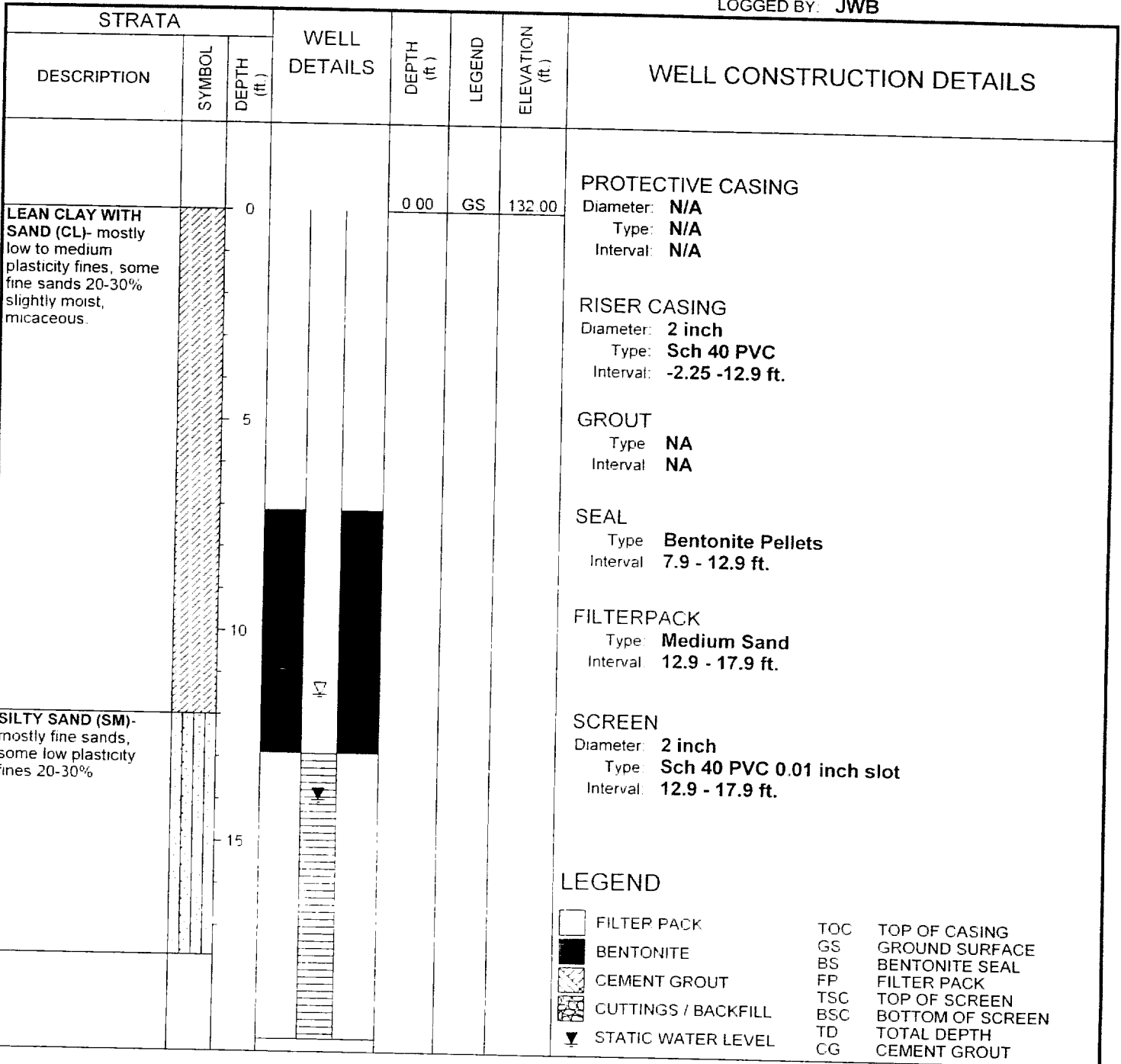
LATITUDE:

LONGITUDE:

TOP OF CASING ELEVATION: 134.30

DATUM: MSL

LOGGED BY: JWB



134 Suber Road
Columbia, SC 29210

COMPLETION REPORT OF
WELL No. B253B

Sheet 1 of 1

COMPLETION REPORT OF WELL No. B253C

Sheet 1 of 1

PROJECT: Congaree Levee
PROJECT NO: 1611-00-937
PROJECT LOCATION: Columbia, South Carolina

WATER LEVEL: Dry at time of boring. Dry on 10/16/00.

DRILLING CONTRACTOR:

DRILLING METHOD: 4 1/4" H.S.A.

DATE DRILLED: 10/5/00


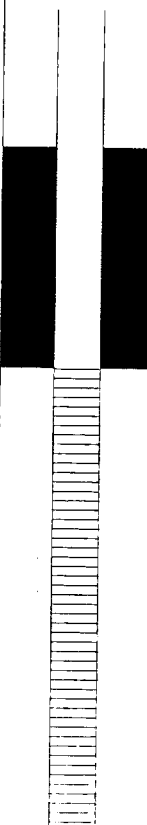





LATITUDE

LONGITUDE

TOP OF CASING ELEVATION 132.50

DATUM MSL

LOGGED BY JWB

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
LEAN CLAY WITH SAND (CL)- mostly low to medium plasticity fines, some fine sands 20-30%, slightly moist, micaceous.		0		0.00	GS	132.00	<p>PROTECTIVE CASING Diameter: N/A Type: N/A Interval: N/A</p> <p>RISER CASING Diameter: 2 inch Type: Sch 40 PVC Interval: -.5 - 3.9 ft.</p> <p>GROUT Type: NA Interval: NA</p> <p>SEAL Type: Bentonite Pellets Interval: 1.5 - 3.9 ft.</p> <p>FILTERPACK Type: Medium Sand Interval: 3.9 - 8.9 ft.</p> <p>SCREEN Diameter: 2 inch Type: Sch 40 PVC 0.01 inch slot Interval: 3.9 - 8.9 ft.</p> <p>LEGEND</p> <div>  FILTER PACK  BENTONITE  CEMENT GROUT  CUTTINGS / BACKFILL  STATIC WATER LEVEL </div> <div> <p>TOC TOP OF CASING GS GROUND SURFACE BS BENTONITE SEAL FP FILTER PACK TSC TOP OF SCREEN BSC BOTTOM OF SCREEN TD TOTAL DEPTH CG CEMENT GROUT</p> </div>

MONITORING WELL 00-937A.GPJ S&ME GDT 10/25/00



134 Suber Road
Columbia, SC 29210

COMPLETION REPORT OF
WELL No. B253C

Sheet 1 of 1

APPENDIX D

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Dry Unit Weight (pcf)	% < #200 Sieve	Classification	Opt Moisture Content	Dry Density (pcf)	Water Content (%)	CBR
B 102 A	23.0					2.6	SP				
B 102 B	8.0					37.6	SM			8.6	
B 126 A	6.0	46	26	20		79.5	CL			17.9	
B 126 B	7.0	46	24	22		84.9	CL			35.3	
B 127 A	20.0					35.7	SM			7.5	
B 141 A	10.0					17.5	SM			4.8	
B 141 B	23.0					17.0	SM			9.4	
B 240 A	9.0	41	25	16		87.3	CL			19.9	
B 240 B	23.0						SP				
B 253 A	23.0					10.0	SP-SM			34.2	
B 253 B	17.0					17.0	SM				
B 254 C	9.0	44	24	20		80.5	CL				



Summary of Laboratory Results

Project CONGAREE LEVEE

Location COLUMBIA, SOUTH CAROLINA

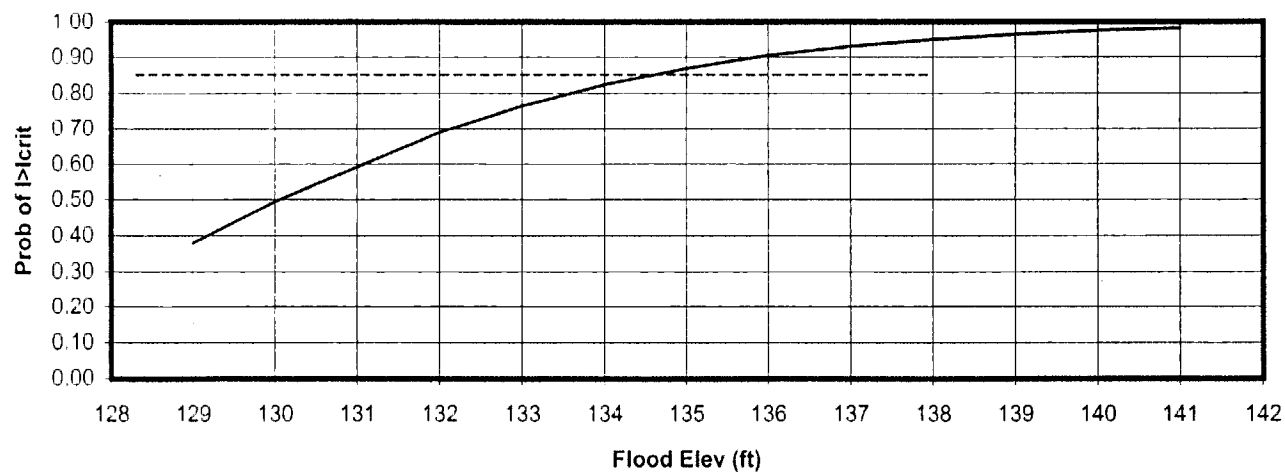
Number: 1611-00-937

APPENDIX E

crest elev		140 ft
elev of toe (inside)		119 ft
elev of toe (outside)		129 ft
crest width		20 ft
inside slope		1.35 H:V
outside slope		1.6 H:V
dist to river channel	L1	150 ft
dist to seepage block	L3	30 ft
Width of Levee at base	L2	65.95 ft
Tailwater Elevation		0 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.E-05	30	9.E-06	4.E-05	2.E-05
Top Blanket Permeability (outside)	1.E-05	30	4.E-06	2.E-05	1.E-05
Top Blanket Permeability (Inside)	1.E-06	30	3.E-07	1.E-06	7.E-07
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	112	2.23	2.5	114.5	109.5

South Failure at WWTP (1976)

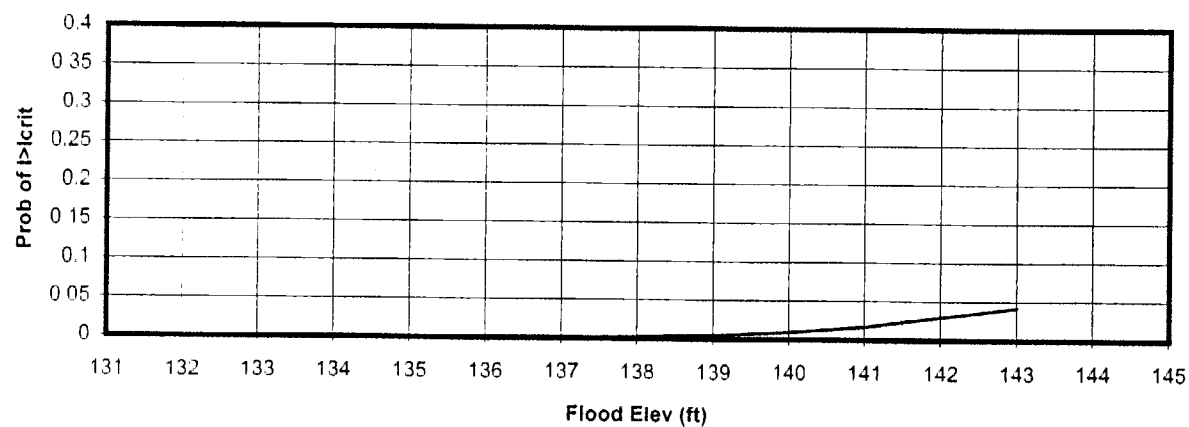


Probability of Failure Function - City of Columbia WWTP 1976 South Failure

crest elev		144.5 ft
elev of toe (inside)		125 ft
elev of toe (outside)		132.1 ft
crest width		11 ft
inside slope		2.05 H:V
outside slope		1.4 H:V
dist to river channel	L1	100 ft
dist to seepage block	L3	20 ft
Width of Levee at base	L2	68.335 ft
Tailwater Elevation		125 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.0E-04	30	9.0E-05	3.9E-04	2.1E-04
Top Blanket Permeability (outside)	1.0E-04	30	3.0E-05	1.3E-04	7.0E-05
Top Blanket Permeability (Inside)	5.0E-05	30	1.5E-05	6.5E-05	3.5E-05
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	110	2.27	2.5	112.5	107.5

Xsect 1A

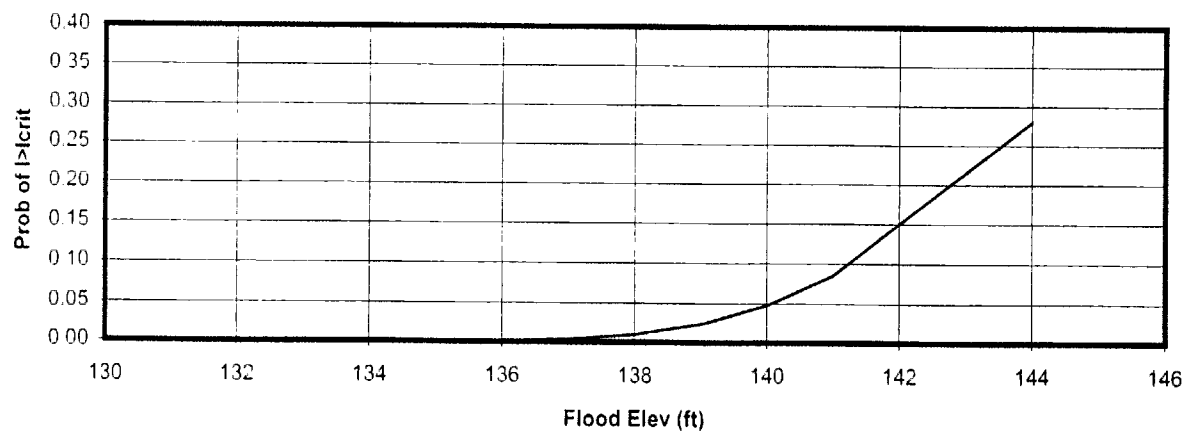


Probability of Failure Function - Section 1A

crest elev		144.7 ft
elev of toe (inside)		127 ft
elev of toe (outside)		132 ft
crest width		11 ft
inside slope		2.67 H:V
outside slope		2.1 H:V
dist to river channel	L1	0 ft
dist to seepage block	L3	20 ft
Width of Levee at base	L2	69.415 ft
Tailwater Elevation		127 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	5.0E-04	30	1.5E-04	6.5E-04	3.5E-04
Top Blanket Permeability (outside)	1.0E-04	30	3.0E-05	1.3E-04	7.0E-05
Top Blanket Permeability (Inside)	5.0E-05	30	1.5E-05	6.5E-05	3.5E-05
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	113	2.21	2.5	115.5	110.5

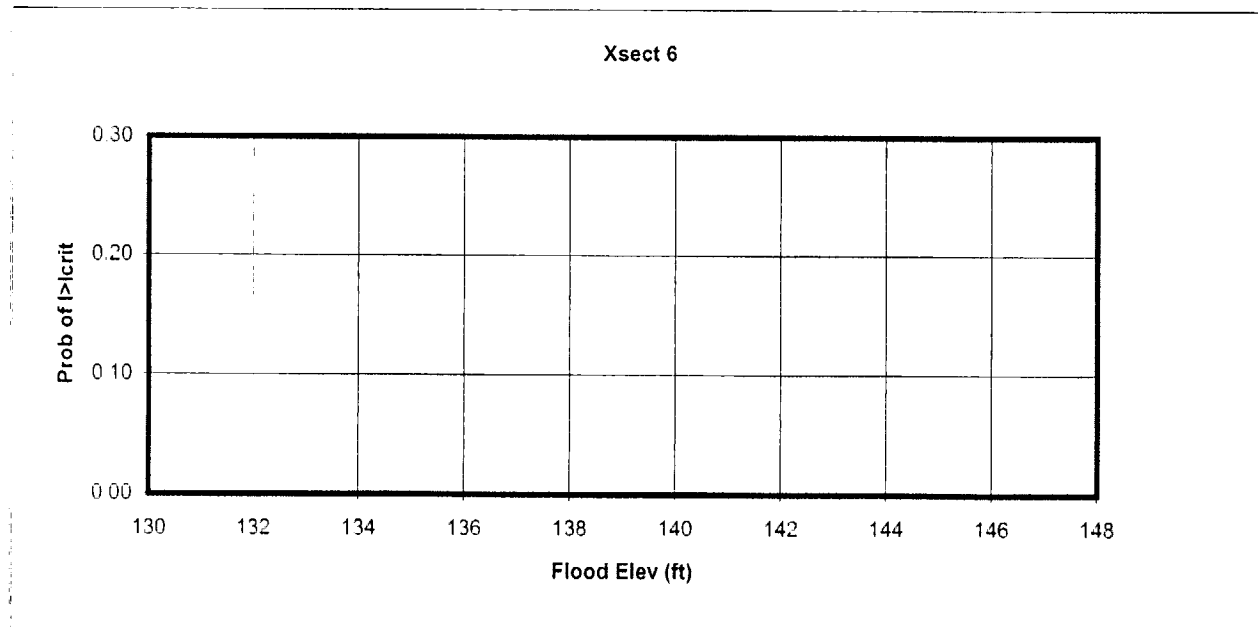
Xsect 3



Probability of Failure Function - Section 3

crest elev		149.7 ft
elev of toe (inside)		128 ft
elev of toe (outside)		135 ft
crest width		10 ft
inside slope		2.2 H:V
outside slope		1.6 H:V
dist to river channel	L1	110 ft
dist to seepage block	L3	100 ft
Width of Levee at base	L2	81.26 ft
Tailwater Elevation		0 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.0E-05	30	9.0E-06	3.9E-05	2.1E-05
Top Blanket Permeability (outside)	1.4E-05	30	4.2E-06	1.8E-05	9.9E-06
Top Blanket Permeability (Inside)	6.0E-06	30	1.8E-06	7.8E-06	4.2E-06
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	120	2.08	2.5	122.5	117.5

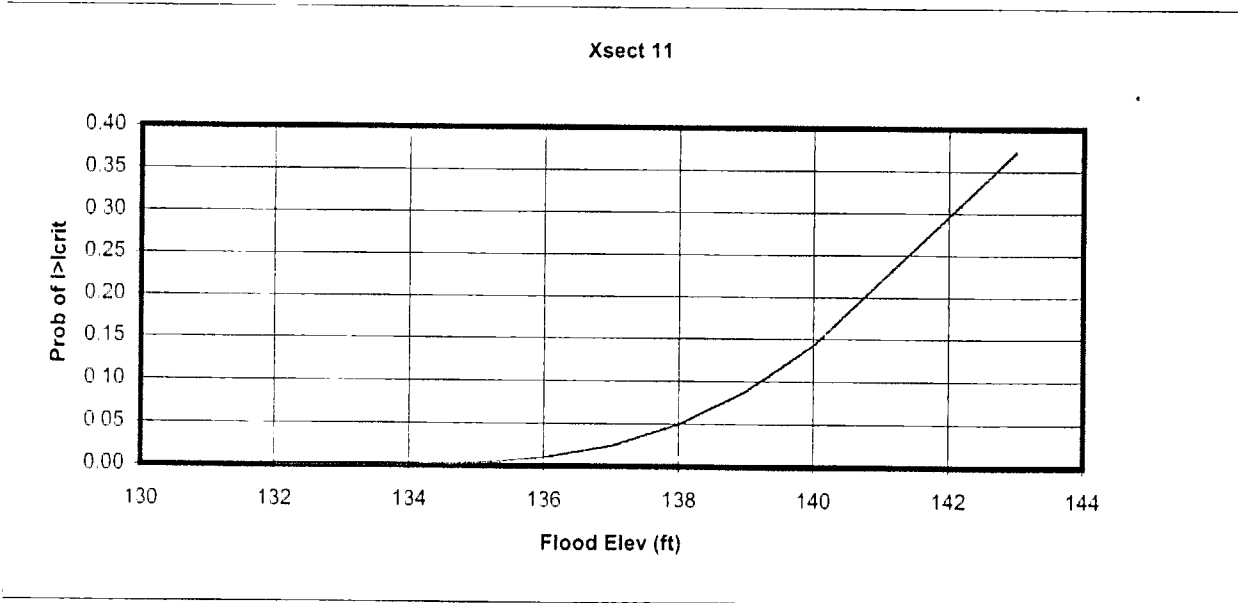


Probability of Failure Function - Cross Section 6

Cross Section 11

crest elev		145 ft
elev of toe (inside)		125 ft
elev of toe (outside)		128 ft
crest width		10 ft
inside slope		1.7 H:V
outside slope		2.3 H:V
dist to river channel	L1	240 ft
dist to seepage block	L3	20 ft
Width of Levee at base	L2	82.1 ft
Tailwater Elevation		125 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.E-04	30	9.0E-05	3.9E-04	2.1E-04
Top Blanket Permeability (outside)	1.4E-05	30	4.2E-06	1.8E-05	9.8E-06
Top Blanket Permeability (Inside)	1.4E-05	30	4.2E-06	1.8E-05	9.8E-06
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	112	2.23	2.5	114.5	109.5

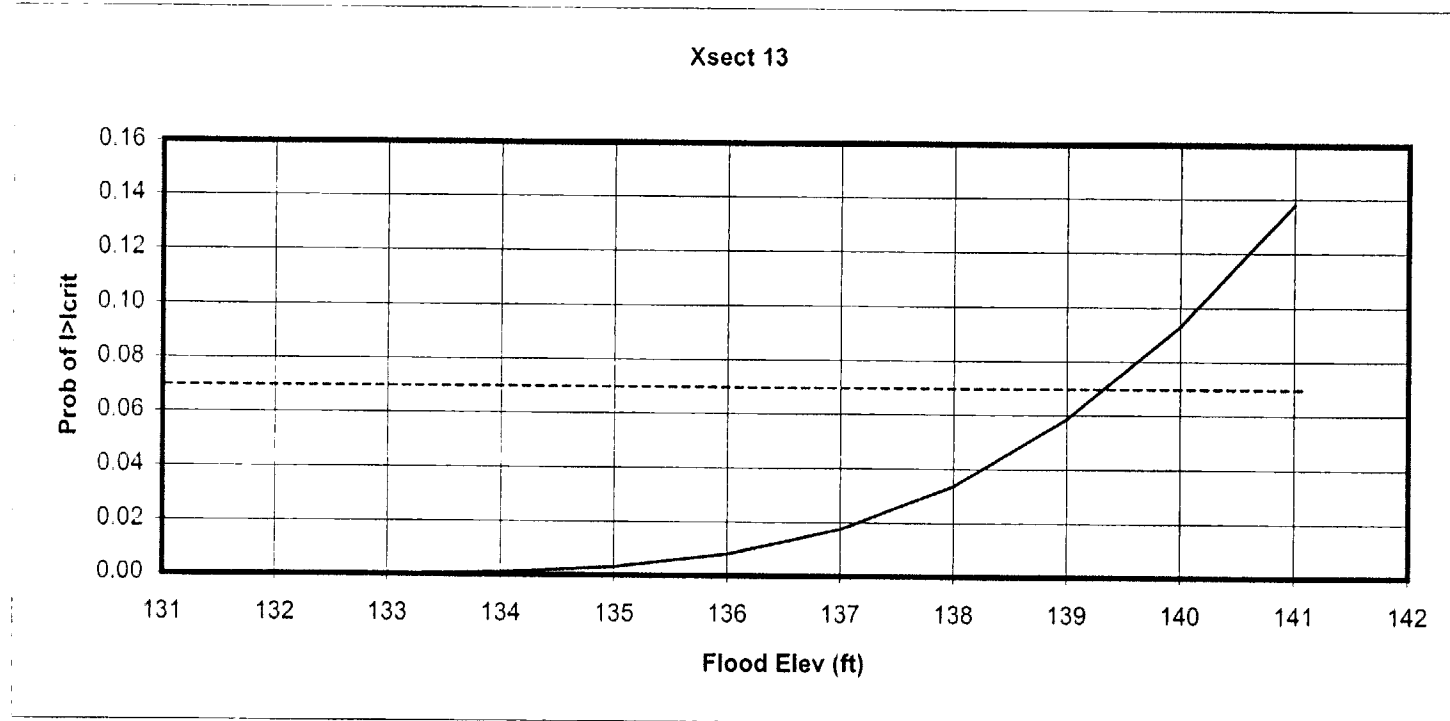


Probability of Failure Function - Section 11

Cross Section 13

crest elev		145.5 ft
elev of toe (inside)		123 ft
elev of toe (outside)		135 ft
crest width		11 ft
inside slope		2.2 H:V
outside slope		2.2 H:V
dist to river channel	L1	55 ft
dist to seepage block	L3	30 ft
Width of Levee at base	L2	83.6 ft
Tailwater Elevation		0 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.E-04	30	9.E-05	4.E-04	2.E-04
Top Blanket Permeability (outside)	3.E-05	30	9.E-06	4.E-05	2.E-05
Top Blanket Permeability (Inside)	1.E-05	30	4.E-06	2.E-05	1.E-05
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	107	2.34	2.5	109.5	104.5

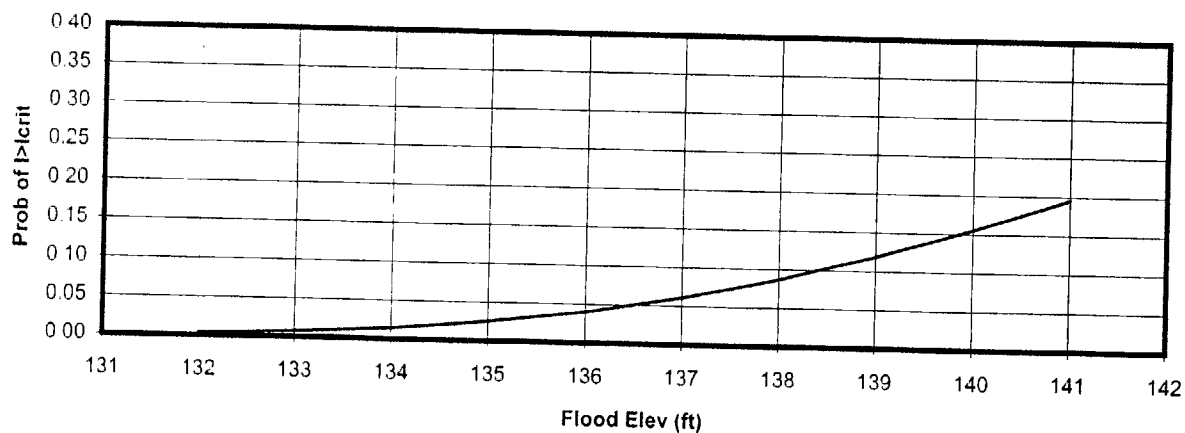


Probability of Failure Function - Cross Section 13

crest elev		144.5 ft
elev of toe (inside)		121 ft
elev of toe (outside)		134 ft
crest width		11 ft
inside slope		2.36 H:V
outside slope		2.67 H:V
dist to river channel	L1	70 ft
dist to seepage block	L3	20 ft
Width of Levee at base	L2	94.495 ft
Tailwater Elevation		0 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.0E-04	30	9.0E-05	3.9E-04	2.1E-04
Top Blanket Permeability (outside)	3.0E-05	30	9.0E-06	3.9E-05	2.1E-05
Top Blanket Permeability (Inside)	3.0E-05	30	9.0E-06	3.9E-05	2.1E-05
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	108	2.31	2.5	110.5	105.5

Xsect 15



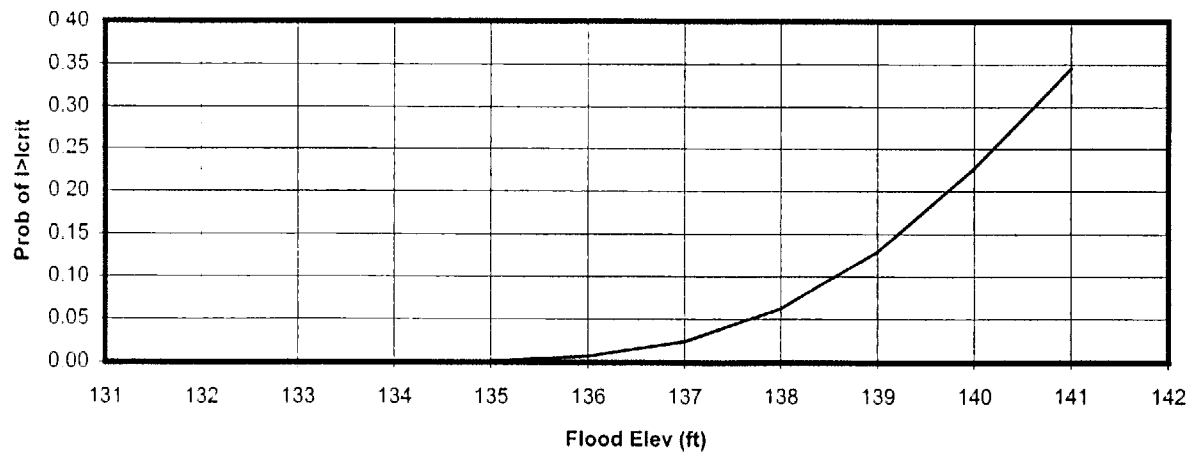
Probability of Failure Function - Cross Section 15

CROSS SECTION 16

crest elev		142 ft
elev of toe (inside)		125 ft
elev of toe (outside)		129 ft
crest width		11 ft
inside slope		1.6 H:V
outside slope		2.3 H:V
dist to river channel	L1	80 ft
dist to seepage block	L3	20 ft
Width of Levee at base	L2	68.1 ft
Tailwater Elevation		0 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.E-04	30	9.E-05	4.E-04	2.E-04
Top Blanket Permeability (outside)	1.E-04	30	3.E-05	1.E-04	7.E-05
Top Blanket Permeability (Inside)	1.E-05	30	3 E-06	1.E-05	7.E-06
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	110	2.27	2.5	112.5	107.5

Xsect 16

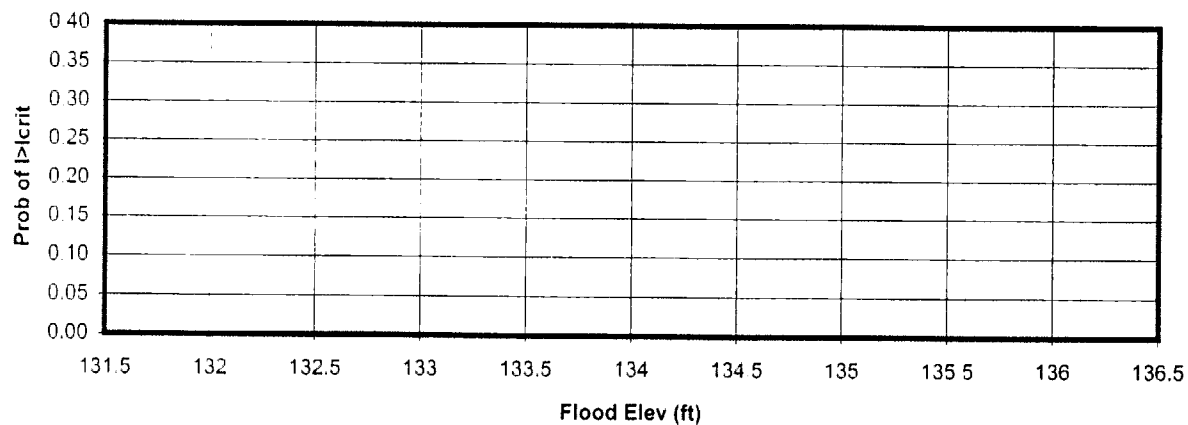


Probability of Failure Function - Cross Section 16

crest elev		142 ft
elev of toe (inside)		127 ft
elev of toe (outside)		122 ft
crest width		20 ft
inside slope		2 H:V
outside slope		2 H:V
dist to river channel	L1	10 ft
dist to seepage block	L3	30 ft
Width of Levee at base	L2	90 ft
Tailwater Elevation		127 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.0E-05	30	9.0E-06	3.9E-05	2.1E-05
Top Blanket Permeability (outside)	6.0E-06	30	1.8E-06	7.8E-06	4.2E-06
Top Blanket Permeability (Inside)	6.0E-06	30	1.8E-06	7.8E-06	4.2E-06
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	119	2.10	2.5	121.5	116.5

Xsect 30

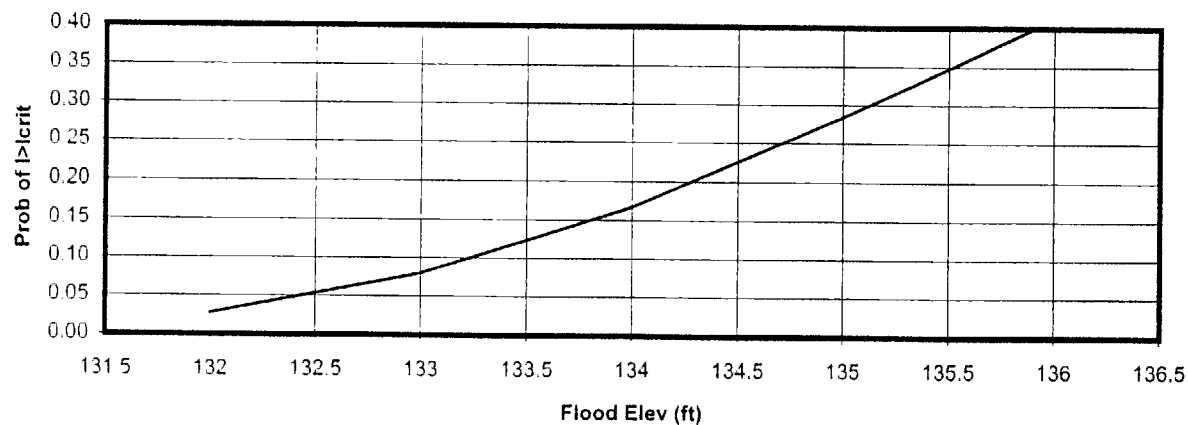


Probability of Failure Function - Cross Section 30

crest elev		135 ft
elev of toe (inside)		126 ft
elev of toe (outside)		126 ft
crest width		20 ft
inside slope		2 H:V
outside slope		2 H:V
dist to river channel	L1	10 ft
dist to seepage block	L3	30 ft
Width of Levee at base	L2	56 ft
Tailwater Elevation		126 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.0E-05	30	9.0E-06	3.9E-05	2.1E-05
Top Blanket Permeability (outside)	1.4E-05	30	4.2E-06	1.8E-05	9.8E-06
Top Blanket Permeability (Inside)	1.0E-06	30	3.0E-07	1.3E-06	7.0E-07
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	118	2.12	2.5	120.5	115.5

Xsect 36

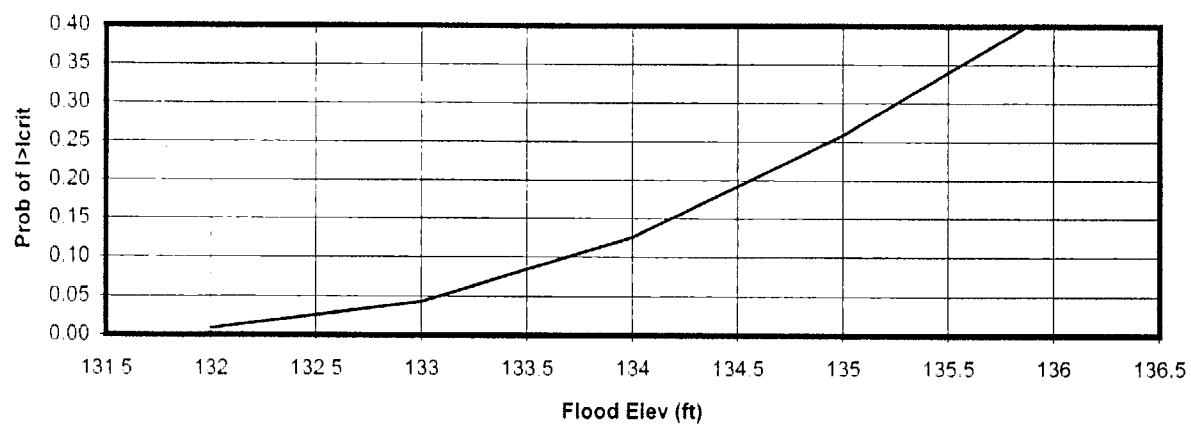


Probability of Failure Function - Cross Section 36

crest elev		136 ft
elev of toe (inside)		126 ft
elev of toe (outside)		126 ft
crest width		20 ft
inside slope		2 H:V
outside slope		2 H:V
dist to river channel	L1	10 ft
dist to seepage block	L3	30 ft
Width of Levee at base	L2	60 ft
Tailwater Elevation		126 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.0E-04	30	9.0E-05	3.9E-04	2.1E-04
Top Blanket Permeability (outside)	9.2E-08	30	2.8E-08	1.2E-07	6.5E-08
Top Blanket Permeability (Inside)	9.2E-08	30	2.8E-08	1.2E-07	6.5E-08
Thickness of Pervious Layer	15	50	8	22.5	7.5
Top elev of pervious layer	115	2.17	2.5	117.5	112.5

Xsect 38

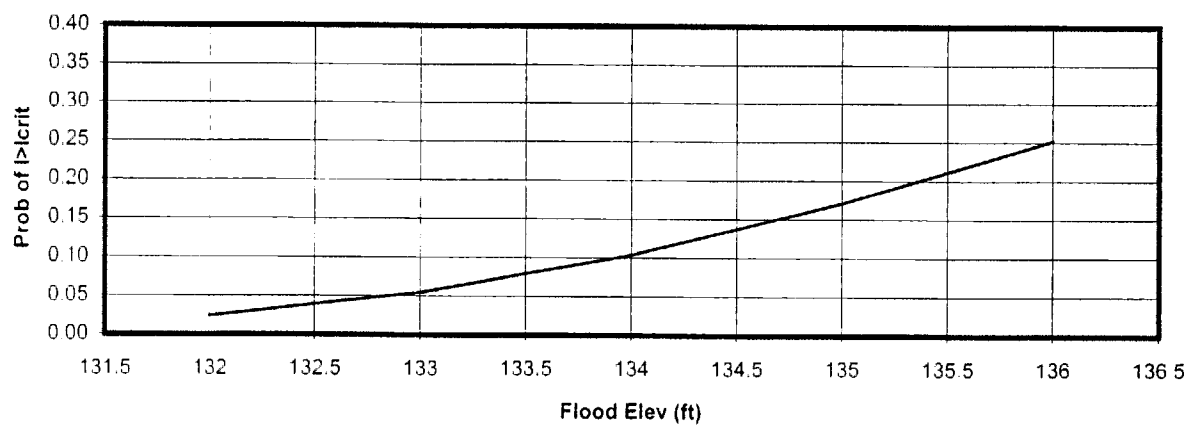


Probability of Failure Function - Cross Section 38

crest elev		136 ft
elev of toe (inside)		124 ft
elev of toe (outside)		124 ft
crest width		20 ft
inside slope		2 H:V
outside slope		2 H:V
dist to river channel	L1	30 ft
dist to seepage block	L3	30 ft
Width of Levee at base	L2	68 ft
Tailwater Elevation		0 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.0E-04	30	9.0E-05	3.9E-04	2.1E-04
Top Blanket Permeability (outside)	1.4E-05	30	4.2E-06	1.8E-05	9.8E-06
Top Blanket Permeability (Inside)	1.4E-05	30	4.2E-06	1.8E-05	9.8E-06
Thickness of Pervious Layer	20	50	10	30.0	10.0
Top elev of pervious layer	115	2.17	2.5	117.5	112.5

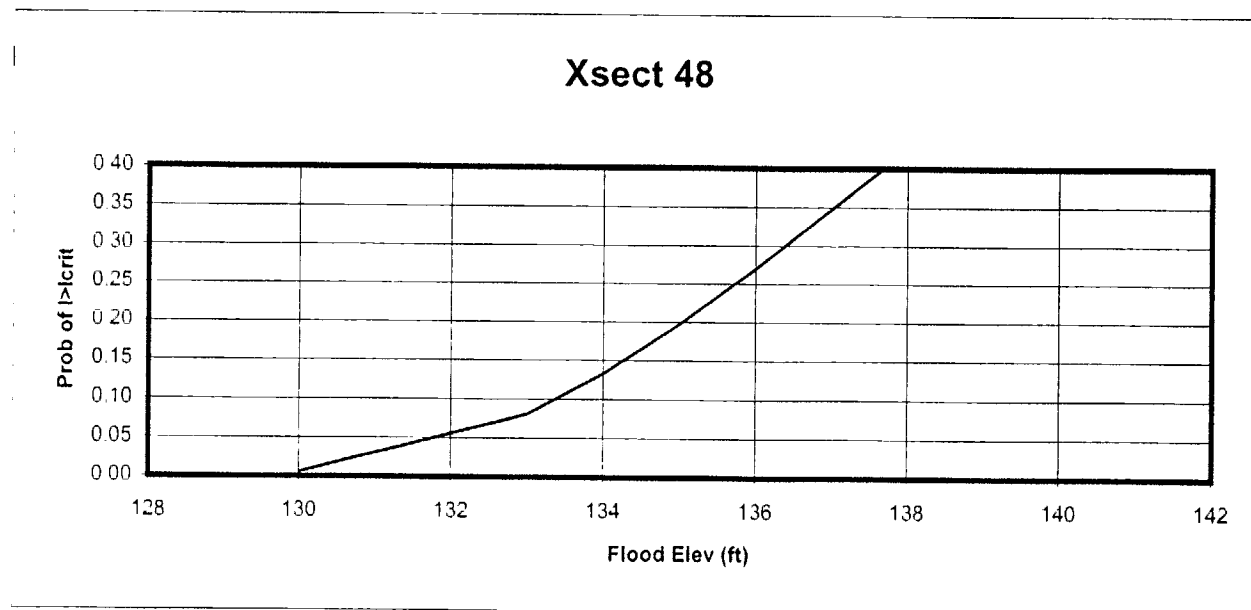
Xsect 41



Probability of Failure Function - Cross Section 41

crest elev		135 ft
elev of toe (inside)		124 ft
elev of toe (outside)		121 ft
crest width		20 ft
inside slope		2 H:V
outside slope		2 H:V
dist to river channel	L1	10 ft
dist to seepage block	L3	30 ft
Width of Levee at base	L2	70 ft
Tailwater Elevation		124 ft

	average	variance	std dev	avg+std dev	avg - std dev
Substratum Permeability	3.0E-04	30	9.0E-05	3.9E-04	2.1E-04
Top Blanket Permeability (outside)	3.0E-05	30	9.0E-06	3.9E-05	2.1E-05
Top Blanket Permeability (Inside)	3.0E-05	30	9.0E-06	3.9E-05	2.1E-05
Thickness of Pervious Layer	25	50	13	37.5	12.5
Top elev of pervious layer	117	2.14	2.5	119.5	114.5



Probability of Failure Function - Cross Section 48

SUMMARY OF REVISED HEC-2 MODELS 10-26-00

Four separate HEC-2 models are included with this submission. This brief summary will describe the purpose of each of the models, as well as all changes and revisions to the FEMA HEC-2 models of 10-26-00 to create the models presented.

Lexington Multiple Model

This model was created to predict base flood elevations for Lexington County. Base flood elevations for Lexington County are computed with the levee in place, as this is the worst-case scenario. This model is included with this submission as **LXMUL.DAT**. This model has been modified from the Lexington multiple model presented by FEMA on 10-26-00 in the following manner:

- Base for model is HEC-2 model presented by FEMA, **CONLX2KR.DAT**.
- At section 246700, the channel "n" value was changed from 0.040 to 0.038. This change was done for the **LXMUL.DAT** HEC-2 model submitted to FEMA on 10-12-00, however, it was changed back to 0.040 because this cross-section was used as a calibration section. We have performed a sensitivity analysis on this change (documented in the included model **LXSEN.DAT**). The results of this sensitivity analysis show that the maximum change in WSEL (due to the "n" value change from 0.040 to 0.038) is -0.04 foot at section 246700. Upstream of the change are several 0.01 foot increases. Since the change in modeling results is insignificant when changing the channel "n" value from 0.040 to 0.038, the channel "n" value was set at 0.038 for consistency between adjoining upstream and downstream cross-sections.
- At section 247000, the FEMA Lexington multiple model predicts that 134,970 CFS will flow landward of the levee. This is representative of 45.2% of the total flow in the Congaree River during the passage of the 100-year storm event. This flowrate landward of the levee occurs even though the entire flow area landward of the levee has been designated as "ineffective" by the use of "n" = 10. To correct the situation, the data set on GR records for section 247000 was truncated from the top of the levee through the remainder of Richland County. This is technically appropriate, since the concept of the Lexington multiple model is that no flow occurs landward of the levee on the Richland County side.
- At section 250770, the data set landward of the levee through Richland County was truncated as was done at section 247000. At section 250770, the FEMA Lexington multiple HEC-2 model predicts that 125,926 CFS (or 42.2% of the total 100-year flow) will be conveyed landward of the levee. Truncation of the GR point from the levee top landward into Richland County alleviates the problem.

The revised Lexington multiple HEC-2 model (**LXMUL.DAT**) resulting from the above changes yields a much more stable model than the Lexington multiple model presented by FEMA on 10-18-00 (**CONLX2KR.DAT**). The HEC-2 model as presented by FEMA indicates as much as a 2.04 foot drawdown between sections 250770 and 253400. This drawdown significantly affects the computation of Base Flood Elevations for the remainder of the model upstream of section 250770. By truncating the GR records at

247000 and 250770 in the manner indicated, the instability in the HEC-2 model is removed. This truncation of GR points is technically appropriate, since the Lexington model is for the levee in-place scenario, and no effective conveyance is to exist landward of the levee.

Lexington Floodway Model

This model was created to model floodway for Lexington County with the levee in place. This model is included with this submission as **LXFW.DAT**. The base model for creation of the Lexington floodway model is the revised Lexington multiple model, as described above. During floodway computations, the floodway boundary is set at the top of levee location (Richland County side) and the same encroachments are used for the Lexington County side as are used in the FEMA floodway model for the Congaree River, **CONFW2KR.DAT**. All encroachments upstream and downstream of the levee location, for both Richland and Lexington counties, are set at the locations presented in the FEMA floodway model. Some encroachment exceptions exist at sections 246700, 247000, 247200, 248200, 249300, and 249590. At these sections, the floodway boundary is pushed outside the limits of floodway as indicated in the FEMA floodway model **CONFW2KR.DAT**. However, the floodway limits remain at, or on the river side of, the floodway line as presented on the preliminary FIRM for Lexington County on 9-26-00. Therefore, the slight change in floodway boundary from this revised Lexington floodway model and the FEMA's floodway model of 10-18-00 will not change the floodway as mapped by FEMA on the preliminary FIRM for Lexington County (released for comment 9-26-00).

Lexington CLOMR-Ready Floodway Model

This model is based on the revised Lexington floodway model (**LXFW.DAT**), and is included with this submission as **LXFWCLMR.DAT**. This model has been revised to reflect the top of levee elevations that will be required to provide three (3) feet of freeboard in the 500-year storm event, as predicted by the revised Lexington multiple model (**LXMUL.DAT**). This model is CLOMR and No-Rise ready, as it shows no change in floodway delineation from the revised Lexington floodway model, and no change in Base Flood Elevation as compared to the revised Lexington multiple and floodway models.

Lexington Sensitivity Model

This model is based on the Lexington multiple model provided by FEMA on 10-18-00 (**CONLX2KR.DAT**) and is included with this submission as **LXSEN.DAT**. This model quantifies the differences in WSEL that occur when the channel "n" value at section 246700 is changed from 0.040 to 0.038. The results of this model show that the maximum change in WSEL (100-year storm event) is -0.04 foot at section 246700, with several increases of 0.01 foot from section 247000 to section 269300. There is no increase more than 0.01 foot as a result of this modification.

HEC-2 Modeling Summary of Results

River Station	FEMA RESULTS				CLOMR READY RESULTS					DIFFERENCE; FEMA TO CLOMR READY				Difference; Corrected Lex. To CLOMR Lex. BFE (with new levee EL) (feet)
	Lexington BFE per FEMA	Congaree Floodway Boundary per FEMA 10-18-00			Corrected Lexington Multiple BFE	Lexington BFE per LXFWCLMR Model	Congaree Floodway Boundary Lex. Multiple Base; Levee at FW			Lexington BFE	Congaree Floodway Boundary Lex. Multiple Base; Levee at FW			
		Left Encl. Station	Right Encl. Station	Floodway Surcharge			Left Encl. Station	Right Encl. Station	Floodway Surcharge		Left Encl. Station	Right Encl. Station	Floodway Surcharge	
212950	127.96	9139.38	22974.60	0.95	127.96	127.96	9139.38	22974.60	1.00	0.00	0.00	0.00	0.05	0.00
215700	129.52	8030.57	22914.93	0.90	129.52	129.52	8030.57	22914.93	0.76	0.00	0.00	0.00	-0.14	0.00
226700	132.48	10079.12	25766.09	0.62	132.48	132.48	10079.12	25766.09	0.52	0.00	0.00	0.00	-0.10	0.00
234100	135.06	5550.00	22656.00	0.66	135.06	135.06	15014.00	22656.00	0.54	0.00	-9464.00	0.00	-0.12	0.00
238900	136.75	19835.00	35900.00	0.88	136.75	136.75	28331.00	35900.00	0.79	0.00	-8496.00	0.00	-0.09	0.00
239370	136.89	21160.00	35900.00	0.88	136.89	136.89	28331.00	35900.00	0.78	0.00	-7171.00	0.00	-0.10	0.00
239800	136.93	560.00	15700.00	0.93	136.93	136.93	9030.00	15700.00	0.87	0.00	-8470.00	0.00	-0.06	0.00
241500	137.50	6342.05	18692.54	0.85	137.50	137.50	12061.00	18692.54	0.76	0.00	-5718.95	0.00	-0.09	0.00
241850	137.59	6399.08	18865.33	0.86	137.59	137.59	12104.00	18865.33	0.76	0.00	-5704.92	0.00	-0.10	0.00
242049	138.17	5540.00	17240.00	0.90	138.17	138.17	10815.00	17240.00	0.84	0.00	-5275.00	0.00	-0.06	0.00
242050	138.17	5540.00	17240.00	0.90	138.17	138.17	10815.00	17240.00	0.84	0.00	-5275.00	0.00	-0.06	0.00
242120	138.18	5540.00	17240.00	0.90	138.18	138.18	10815.00	17240.00	0.84	0.00	-5275.00	0.00	-0.06	0.00
242121	138.19	5540.00	17240.00	0.91	138.19	138.19	10815.00	17240.00	0.83	0.00	-5275.00	0.00	-0.08	0.00
242169	138.21	5540.00	17240.00	0.91	138.21	138.21	10793.00	17240.00	0.83	0.00	-5253.00	0.00	-0.08	0.00
242170	138.20	5540.00	17240.00	0.91	138.20	138.20	10793.00	17240.00	0.83	0.00	-5253.00	0.00	-0.08	0.00
242240	138.22	5540.00	17240.00	0.91	138.22	138.22	10806.00	17240.00	0.84	0.00	-5266.00	0.00	-0.07	0.00
242241	138.23	5540.00	17240.00	0.91	138.23	138.23	10806.00	17240.00	0.82	0.00	-5266.00	0.00	-0.09	0.00
242440	138.10	5540.00	17600.00	0.89	138.10	138.10	11800.00	17600.00	0.75	0.00	-6260.00	0.00	-0.14	0.00
243000	138.54	6452.90	17859.61	0.83	138.54	138.54	11830.00	17859.61	0.75	0.00	-5377.10	0.00	-0.08	0.00
245800	139.59	5580.00	17300.00	0.92	139.59	139.59	11800.00	17300.00	0.98	0.00	-6220.00	0.00	0.06	0.00
246000	139.79	5589.08	17131.80	0.89	139.79	139.79	11815.00	17131.80	0.88	0.00	-6225.92	0.00	-0.01	0.00
246700	139.80	8900.00	18800.00	0.87	139.76	139.76	14467.00	19200.00	0.97	-0.04	-5567.00	400.00	0.10	0.00
247000	140.76	12729.02	23282.54	0.91	140.25	140.25	18790.00	23582.00	1.00	-0.51	-6060.98	299.46	0.09	0.00
247200	140.26	12445.06	23301.65	0.94	140.25	140.25	18800.00	23601.00	1.03	-0.01	-6354.94	299.35	0.09	0.00
248200	140.62	6340.41	17582.96	0.94	140.62	140.62	12860.00	17682.00	1.02	0.00	-6519.59	99.04	0.08	0.00
249300	141.56	4222.68	13994.81	0.85	141.56	141.56	9390.00	14400.00	0.97	0.00	-5167.32	405.19	0.12	0.00
249590	141.35	7576.92	17206.01	0.85	141.35	141.35	12740.00	17306.00	0.87	0.00	-5163.08	99.99	0.02	0.00
250770	142.07	1620.16	10222.71	0.87	141.57	141.57	5910.00	10222.71	0.90	-0.50	-4289.84	0.00	0.03	0.00
253400	140.03	7628.00	12000.00	0.94	142.72	142.72	9590.00	12000.00	1.04	2.69	-1962.00	0.00	0.10	0.00
254500	141.38	4685.00	5315.00	0.82	143.68	143.68	4685.00	5315.00	0.95	2.30	0.00	0.00	0.13	0.00
254600	141.67	4685.00	5315.00	0.72	143.96	143.96	4685.00	5315.00	0.78	2.29	0.00	0.00	0.06	0.00
255100	142.51	4685.00	5315.00	0.56	144.63	144.63	4685.00	5315.00	0.68	2.12	0.00	0.00	0.12	0.00
256100	143.79	4685.00	5315.00	0.61	145.61	145.61	4685.00	5315.00	0.76	1.82	0.00	0.00	0.15	0.00
257200	144.97	4685.00	5316.53	0.60	146.60	146.60	4685.00	5316.53	0.81	1.63	0.00	0.00	0.21	0.00
258400	145.36	6172.70	6774.11	0.63	146.82	146.82	6172.70	6774.11	0.94	1.46	0.00	0.00	0.31	0.00
259600	146.65	6166.49	6778.74	0.61	147.94	147.94	6166.49	6778.74	0.92	1.29	0.00	0.00	0.31	0.00
260100	147.14	6168.58	6773.78	0.58	148.37	148.37	6168.58	6773.78	0.88	1.23	0.00	0.00	0.30	0.00
260400	149.36	5607.88	6689.00	0.41	150.46	150.46	5607.88	6689.00	0.69	1.10	0.00	0.00	0.28	0.00
260500	149.32	1570.00	2465.00	0.50	150.41	150.41	1570.00	2465.00	0.78	1.09	0.00	0.00	0.28	0.00
260550	149.72	1570.00	2465.00	0.48	150.78	150.78	1570.00	2465.00	0.76	1.06	0.00	0.00	0.28	0.00
260600	149.74	1570.00	2465.00	0.48	150.79	150.79	1570.00	2465.00	0.76	1.05	0.00	0.00	0.28	0.00
260700	150.38	1510.00	2730.00	0.35	151.40	151.40	1510.00	2730.00	0.63	1.02	0.00	0.00	0.28	0.00
260730	150.38	1510.00	2730.00	0.35	151.41	151.41	1510.00	2730.00	0.63	1.03	0.00	0.00	0.28	0.00

HEC-2 Modeling Summary of Results

River Station	FEMA RESULTS				CLOMR READY RESULTS					DIFFERENCE; FEMA TO CLOMR READY				Difference; Corrected Lex. To CLOMR Lex. BFE (with new levee EL) (feet)
	Lexington BFE per FEMA	Congaree Floodway Boundary per FEMA 10-18-00			Corrected Lexington Multiple BFE	Lexington BFE per LXFWCLMR Model	Congaree Floodway Boundary Lex. Multiple Base; Levee at FW			Lexington BFE	Congaree Floodway Boundary Lex. Multiple Base; Levee at FW			
		Left Encr. Station	Right Encr. Station	Floodway Surcharge			Left Encr. Station	Right Encr. Station	Floodway Surcharge		Left Encr. Station	Right Encr. Station	Floodway Surcharge	
260800	150.59	1510.00	2730.00	0.38	151.60	151.60	1510.00	2730.00	0.65	1.01	0.00	0.00	0.27	0.00
261200	150.66	370.00	1684.83	0.38	151.66	151.66	370.00	1684.83	0.65	1.00	0.00	0.00	0.27	0.00
262900	150.94	323.30	1710.50	0.41	151.91	151.91	323.30	1710.50	0.67	0.97	0.00	0.00	0.26	0.00
264500	151.48	1660.00	3130.00	0.43	152.40	152.40	1660.00	3130.00	0.68	0.92	0.00	0.00	0.25	0.00
264600	151.45	1660.00	3130.00	0.48	152.37	152.37	1660.00	3130.00	0.74	0.92	0.00	0.00	0.26	0.00
264750	151.53	1660.00	3130.00	0.48	152.45	152.45	1660.00	3130.00	0.73	0.92	0.00	0.00	0.25	0.00
265200	151.59	1175.73	2285.00	0.25	152.50	152.50	1175.73	2285.00	0.52	0.91	0.00	0.00	0.27	0.00
266750	151.69	4287.44	5471.00	0.51	152.58	152.58	4287.44	5471.00	0.75	0.89	0.00	0.00	0.24	0.00
266900	151.63	4595.00	5405.00	0.47	152.53	152.53	4595.00	5405.00	0.70	0.90	0.00	0.00	0.23	0.00
267400	152.64	821.50	2231.30	0.52	153.47	153.47	821.50	2231.30	0.76	0.83	0.00	0.00	0.24	0.00
267750	152.36	4475.00	5525.00	0.54	153.20	153.20	4475.00	5525.00	0.78	0.84	0.00	0.00	0.24	0.00
267850	152.36	563.00	2000.00	0.54	153.20	153.20	563.00	2000.00	0.78	0.84	0.00	0.00	0.24	0.00
268920	153.08	4260.00	5915.00	0.50	153.88	153.88	4260.00	5915.00	0.73	0.80	0.00	0.00	0.23	0.00
269250	153.14	600.00	2248.00	0.48	153.94	153.94	600.00	2248.00	0.71	0.80	0.00	0.00	0.23	0.00
269300	153.15	600.00	2248.00	0.48	153.95	153.95	600.00	2248.00	0.71	0.80	0.00	0.00	0.23	0.00
270450	153.53	3835.00	6165.00	0.58	154.31	154.31	3835.00	6165.00	0.80	0.78	0.00	0.00	0.22	0.00
272010	153.93	2970.00	5300.00	0.52	154.67	154.67	2970.00	5300.00	0.74	0.74	0.00	0.00	0.22	0.00

HEC-2 Modeling Summary of Results

River Station	FEMA RESULTS				REVISED LEXINGTON MODEL RESULTS					DIFFERENCE; FEMA TO REVISED			
	Lexington BFE per FEMA (ft, MSL)	Congaree Floodway Boundary per FEMA 10-18-00			Corrected Lexington Multiple BFE (ft, MSL)	Lexington BFE per LFW Model (ft, MSL)	Congaree Floodway Boundary Lex. Multiple Base; Levee at FW			Lexington BFE (ft, MSL)	Congaree Floodway Boundary Lex. Multiple Base; Levee at FW		
		Left Encr. Station (Richland)	Right Encr. Station (Lexington)	Floodway Surcharge (ft)			Left Encr. Station (Richland)	Right Encr. Station (Lexington)	Floodway Surcharge (ft)		Left Encr. Station (Richland)	Right Encr. Station (Lexington)	Floodway Surcharge (ft)
212950	127.96	9139.38	22974.60	0.95	127.96	127.96	9139.38	22974.60	1.00	0.00	0.00	0.00	0.05
215700	129.52	8030.57	22914.93	0.90	129.52	129.52	8030.57	22914.93	0.76	0.00	0.00	0.00	-0.14
226700	132.48	10079.12	25766.09	0.62	132.48	132.48	10079.12	25766.09	0.52	0.00	0.00	0.00	-0.10
234100	135.06	5550.00	22656.00	0.66	135.06	135.06	15014.00	22656.00	0.54	0.00	-9464.00	0.00	-0.12
238900	136.75	19835.00	35900.00	0.88	136.75	136.75	28331.00	35900.00	0.79	0.00	-8496.00	0.00	-0.09
239370	136.89	21160.00	35900.00	0.88	136.89	136.89	28331.00	35900.00	0.78	0.00	-7171.00	0.00	-0.10
239800	136.93	560.00	15700.00	0.93	136.93	136.93	9030.00	15700.00	0.87	0.00	-8470.00	0.00	-0.06
241500	137.50	6342.05	18692.54	0.85	137.50	137.50	12061.00	18692.54	0.76	0.00	-5718.95	0.00	-0.09
241850	137.59	6399.08	18865.33	0.86	137.59	137.59	12104.00	18865.33	0.76	0.00	-5704.92	0.00	-0.10
242049	138.17	5540.00	17240.00	0.90	138.17	138.17	10815.00	17240.00	0.84	0.00	-5275.00	0.00	-0.06
242050	138.17	5540.00	17240.00	0.90	138.17	138.17	10815.00	17240.00	0.84	0.00	-5275.00	0.00	-0.06
242120	138.18	5540.00	17240.00	0.90	138.18	138.18	10815.00	17240.00	0.84	0.00	-5275.00	0.00	-0.06
242121	138.19	5540.00	17240.00	0.91	138.19	138.19	10815.00	17240.00	0.83	0.00	-5275.00	0.00	-0.08
242169	138.21	5540.00	17240.00	0.91	138.21	138.21	10793.00	17240.00	0.83	0.00	-5253.00	0.00	-0.08
242170	138.20	5540.00	17240.00	0.91	138.20	138.20	10793.00	17240.00	0.83	0.00	-5253.00	0.00	-0.08
242240	138.22	5540.00	17240.00	0.91	138.22	138.22	10806.00	17240.00	0.84	0.00	-5266.00	0.00	-0.07
242241	138.23	5540.00	17240.00	0.91	138.23	138.23	10806.00	17240.00	0.82	0.00	-5266.00	0.00	-0.09
242440	138.10	5540.00	17600.00	0.89	138.10	138.10	11800.00	17600.00	0.75	0.00	-6260.00	0.00	-0.14
243000	138.54	6452.90	17859.61	0.83	138.54	138.54	11830.00	17859.61	0.75	0.00	-5377.10	0.00	-0.08
245800	139.59	5580.00	17300.00	0.92	139.59	139.59	11800.00	17300.00	0.98	0.00	-6220.00	0.00	0.06
246000	139.79	5589.08	17131.80	0.89	139.79	139.79	11815.00	17131.80	0.88	0.00	-6225.92	0.00	-0.01
246700	139.80	8900.00	18800.00	0.87	139.76	139.76	14467.00	19200.00	0.97	-0.04	-5567.00	400.00	0.10
247000	140.76	12729.02	23282.54	0.91	140.25	140.25	18790.00	23582.00	1.00	-0.51	-6060.98	299.46	0.09
247200	140.26	12445.06	23301.65	0.94	140.25	140.25	18800.00	23601.00	1.03	-0.01	-6354.94	299.35	0.09
248200	140.62	6340.41	17582.96	0.94	140.62	140.62	12860.00	17682.00	1.02	0.00	-6519.59	99.04	0.08
249300	141.56	4222.68	13994.81	0.85	141.56	141.56	9390.00	14400.00	0.97	0.00	-5167.32	405.19	0.12
249590	141.35	7576.92	17206.01	0.85	141.35	141.35	12740.00	17306.00	0.87	0.00	-5163.08	99.99	0.02
250770	142.07	1620.16	10222.71	0.87	141.57	141.57	5910.00	10222.71	0.90	-0.50	-4289.84	0.00	0.03
253400	140.03	7628.00	12000.00	0.94	142.72	142.72	9590.00	12000.00	1.04	2.69	-1962.00	0.00	0.10
254500	141.38	4685.00	5315.00	0.82	143.68	143.68	4685.00	5315.00	0.95	2.30	0.00	0.00	0.13
254600	141.67	4685.00	5315.00	0.72	143.96	143.96	4685.00	5315.00	0.78	2.29	0.00	0.00	0.06
255100	142.51	4685.00	5315.00	0.56	144.63	144.63	4685.00	5315.00	0.68	2.12	0.00	0.00	0.12
256100	143.79	4685.00	5315.00	0.61	145.61	145.61	4685.00	5315.00	0.76	1.82	0.00	0.00	0.15
257200	144.97	4685.00	5316.53	0.60	146.60	146.60	4685.00	5316.53	0.81	1.63	0.00	0.00	0.21
258400	145.36	6172.70	6774.11	0.63	146.82	146.82	6172.70	6774.11	0.94	1.46	0.00	0.00	0.31
259600	146.65	6166.49	6778.74	0.61	147.94	147.94	6166.49	6778.74	0.92	1.29	0.00	0.00	0.31
260100	147.14	6168.58	6773.78	0.58	148.37	148.37	6168.58	6773.78	0.88	1.23	0.00	0.00	0.30

FEMA vs Revised Lexington Model

HEC-2 Modeling Summary of Results

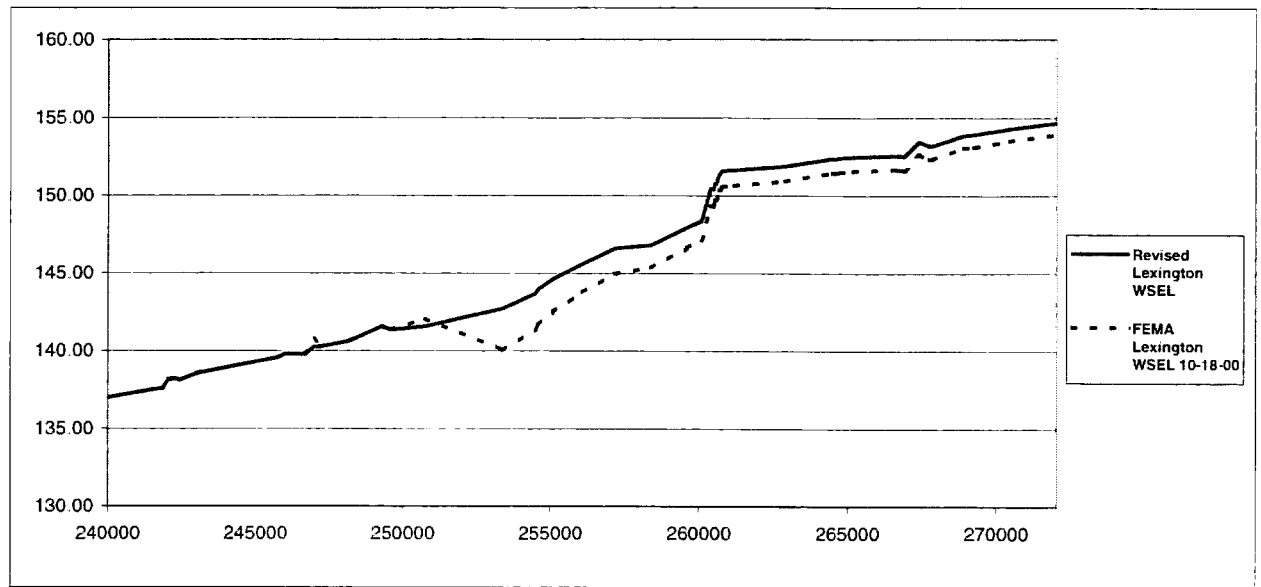
River Station	FEMA RESULTS				REVISED LEXINGTON MODEL RESULTS					DIFFERENCE; FEMA TO REVISED			
	Lexington BFE per FEMA (ft, MSL)	Congaree Floodway Boundary per FEMA 10-18-00			Corrected Lexington Multiple BFE (ft, MSL)	Lexington BFE per LXFW Model (ft, MSL)	Congaree Floodway Boundary Lex. Multiple Base; Levee at FW			Lexington BFE (ft, MSL)	Congaree Floodway Boundary Lex. Multiple Base; Levee at FW		
		Left Encr. Station (Richland)	Right Encr. Station (Lexington)	Floodway Surcharge (ft)			Left Encr. Station (Richland)	Right Encr. Station (Lexington)	Floodway Surcharge (ft)		Left Encr. Station (Richland)	Right Encr. Station (Lexington)	Floodway Surcharge (ft)
260400	149.36	5607.88	6689.00	0.41	150.46	150.46	5607.88	6689.00	0.69	1.10	0.00	0.00	0.28
260500	149.32	1570.00	2465.00	0.50	150.41	150.41	1570.00	2465.00	0.78	1.09	0.00	0.00	0.28
260550	149.72	1570.00	2465.00	0.48	150.78	150.78	1570.00	2465.00	0.76	1.06	0.00	0.00	0.28
260600	149.74	1570.00	2465.00	0.48	150.79	150.79	1570.00	2465.00	0.76	1.05	0.00	0.00	0.28
260700	150.38	1510.00	2730.00	0.35	151.40	151.40	1510.00	2730.00	0.63	1.02	0.00	0.00	0.28
260730	150.38	1510.00	2730.00	0.35	151.41	151.41	1510.00	2730.00	0.63	1.03	0.00	0.00	0.28
260800	150.59	1510.00	2730.00	0.38	151.60	151.60	1510.00	2730.00	0.65	1.01	0.00	0.00	0.27
261200	150.66	370.00	1684.83	0.38	151.66	151.66	370.00	1684.83	0.65	1.00	0.00	0.00	0.27
262900	150.94	323.30	1710.50	0.41	151.91	151.91	323.30	1710.50	0.67	0.97	0.00	0.00	0.26
264500	151.48	1660.00	3130.00	0.43	152.40	152.40	1660.00	3130.00	0.68	0.92	0.00	0.00	0.25
264600	151.45	1660.00	3130.00	0.48	152.37	152.37	1660.00	3130.00	0.74	0.92	0.00	0.00	0.26
264750	151.53	1660.00	3130.00	0.48	152.45	152.45	1660.00	3130.00	0.73	0.92	0.00	0.00	0.25
265200	151.59	1175.73	2285.00	0.25	152.50	152.50	1175.73	2285.00	0.52	0.91	0.00	0.00	0.27
266750	151.69	4287.44	5471.00	0.51	152.58	152.58	4287.44	5471.00	0.75	0.89	0.00	0.00	0.24
266900	151.63	4595.00	5405.00	0.47	152.53	152.53	4595.00	5405.00	0.70	0.90	0.00	0.00	0.23
267400	152.64	821.50	2231.30	0.52	153.47	153.47	821.50	2231.30	0.76	0.83	0.00	0.00	0.24
267750	152.36	4475.00	5525.00	0.54	153.20	153.20	4475.00	5525.00	0.78	0.84	0.00	0.00	0.24
267850	152.36	563.00	2000.00	0.54	153.20	153.20	563.00	2000.00	0.78	0.84	0.00	0.00	0.24
268920	153.08	4260.00	5915.00	0.50	153.88	153.88	4260.00	5915.00	0.73	0.80	0.00	0.00	0.23
269250	153.14	600.00	2248.00	0.48	153.94	153.94	600.00	2248.00	0.71	0.80	0.00	0.00	0.23
269300	153.15	600.00	2248.00	0.48	153.95	153.95	600.00	2248.00	0.71	0.80	0.00	0.00	0.23
270450	153.53	3835.00	6165.00	0.58	154.31	154.31	3835.00	6165.00	0.80	0.78	0.00	0.00	0.22
272010	153.93	2970.00	5300.00	0.52	154.67	154.67	2970.00	5300.00	0.74	0.74	0.00	0.00	0.22

Model Left Overbank flowrates and WSEL tabulation

Base model for this comparison is the revised Lexington multiple HEC-2 model, based on the revised Lexington multiple HEC-2 model presented by FEMA on 10-18-00. The changes made to the FEMA Lexington model provide a much more stable HEC-2 model with the levee in place. Note the removal of the instabilities in WSEL when comparing the FEMA Lexington multiple model with the revised Lexington multiple model.

River Station	Computed WSEL (ft)	Computed EGL (ft)	Slope EGL X 10,000	.01 X Conveyance	Total Flowrate (CFS)	Left Overbank Flowrate (CFS)	Channel Flowrate (CFS)	Right Overbank Flowrate (CFS)	% total flow in LOB
212950	127.96	128.42	6.13	120548	298400	167757	120858	9785	56.2%
215700	129.52	129.85	4.42	141905	298400	174506	113106	10788	58.5%
226700	132.48	132.82	3.48	159960	298400	12256	124991	161153	4.1%
234100	135.06	135.66	3.96	149938	298400	27573	197563	73264	9.2%
238900	136.75	137.29	3.40	161793	298400	25815	196038	76548	8.7%
239370	136.89	137.46	3.51	159216	298400	26545	200138	71717	8.9%
239800	136.93	137.69	4.53	140221	298400	5909	217283	75208	2.0%
241500	137.50	138.25	3.14	168344	298400	2592	225435	70372	0.9%
241850	137.59	138.38	3.23	166055	298400	2357	229605	66437	0.8%
242049	138.17	138.55	2.70	181732	298400	1901	146412	150088	0.6%
242050	138.17	138.56	2.59	185521	298400	467	149621	148312	0.2%
242120	138.18	138.58	2.58	185692	298400	467	149573	148361	0.2%
242121	138.19	138.58	2.56	186577	298400	1827	148868	147705	0.6%
242169	138.21	138.59	2.55	186806	298400	1829	148734	147837	0.6%
242170	138.20	138.59	2.57	185963	298400	467	149426	148507	0.2%
242240	138.22	138.61	2.58	185850	298400	468	149563	148369	0.2%
242241	138.23	138.62	2.54	187084	298400	1788	148619	147993	0.6%
242440	138.10	138.88	4.17	146213	298400	2594	218972	76834	0.9%
243000	138.54	139.13	4.11	147271	298400	3928	192526	101946	1.3%
245800	139.59	140.17	3.81	152932	298400	3523	196151	98726	1.2%
246000	139.79	140.25	3.20	166858	298400	3586	181736	113079	1.2%
246700	139.76	140.71	6.36	118284	298400	5117	217395	75888	1.7%
247000	140.25	140.89	3.88	151551	298400	898	204873	92629	0.3%
247200	140.25	141.00	4.31	143658	298400	2721	216172	79507	0.9%
248200	140.62	141.49	4.70	137657	298400	4799	207329	86272	1.6%
249300	141.56	141.89	2.25	199025	298400	4315	142512	151573	1.4%
249590	141.35	142.10	4.35	143020	298400	6908	196006	95486	2.3%
250770	141.57	142.87	6.13	120542	298400	3317	228669	66414	1.1%
253400	142.72	145.15	9.04	99263	298400	3275	283834	11291	1.1%
254500	143.68	146.25	9.73	95651	298400	14	291614	6772	0.0%
254600	143.96	146.39	9.23	98199	298400	17	287578	10805	0.0%
255100	144.63	146.89	8.54	102139	298400	21	283931	14447	0.0%
256100	145.61	147.74	7.79	106942	298400	2147	283454	12799	0.7%
257200	146.60	148.59	7.08	112127	298400	6366	282298	9736	2.1%
258400	146.82	149.79	7.99	105579	298400	6264	275386	16750	2.1%
259600	147.94	150.72	7.26	110709	298400	6808	274353	17239	2.3%
260100	148.37	151.08	7.01	112716	298400	7020	273959	17421	2.4%
260400	150.46	151.36	1.80	222399	298400	43886	253171	1343	14.7%
260500	150.41	151.65	2.65	183134	298400	0	298400	0	0.0%
260550	150.78	152.00	2.57	186147	298400	0	298400	0	0.0%
260600	150.79	152.01	2.57	186255	298400	0	298400	0	0.0%
260700	151.40	152.08	1.83	220514	298400	0	298400	0	0.0%
260730	151.41	152.09	1.83	220580	298400	0	298400	0	0.0%
260800	151.60	152.27	1.80	222619	298400	0	298400	0	0.0%
261200	151.66	152.35	1.68	230361	298400	6537	269060	22803	2.2%
262900	151.91	152.69	2.05	208471	298400	5576	271000	21824	1.9%
264500	152.40	153.01	1.73	227049	298400	11107	287225	67	3.7%
264600	152.37	153.05	1.87	218151	298400	0	298400	0	0.0%
264750	152.45	153.12	1.86	219085	298400	0	298400	0	0.0%
265200	152.50	153.22	1.91	216185	298400	35899	262501	0	12.0%
266750	152.58	153.66	2.38	189303	292000	5315	284990	1694	1.8%
266900	152.53	153.74	2.53	183587	292000	5408	283777	2816	1.9%
267400	153.47	153.88	0.84	318674	292000	4614	285142	2244	1.6%
267750	153.20	154.25	2.54	183264	292000	0	292000	0	0.0%
267850	153.20	154.25	1.23	262979	292000	0	292000	0	0.0%
268920	153.88	154.40	1.49	239362	292000	0	288267	3733	0.0%
269250	153.94	154.48	2.88	171914	292000	12010	279552	438	4.1%
269300	153.95	154.49	2.88	172061	292000	12016	279545	439	4.1%
270450	154.31	154.78	1.94	209409	292000	0	291796	204	0.0%
272010	154.67	155.08	1.61	229792	292000	1805	285707	4487	0.6%

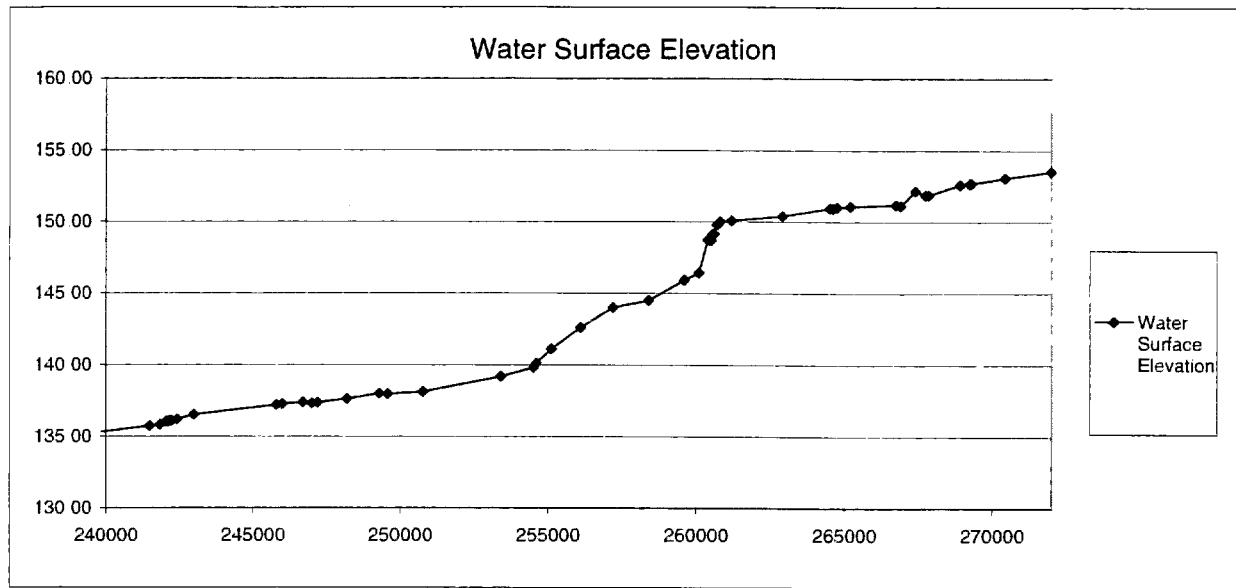
Revised Lexington Model



Model Left Overbank flowrates and WSEL tabulation

Base model for this comparison is the Richland multiple HEC-2 model, presented by FEMA in Atlanta on 10-18-00. This HEC-2 model assumes the levee has breached, and conveyance will occur landward of the levee.

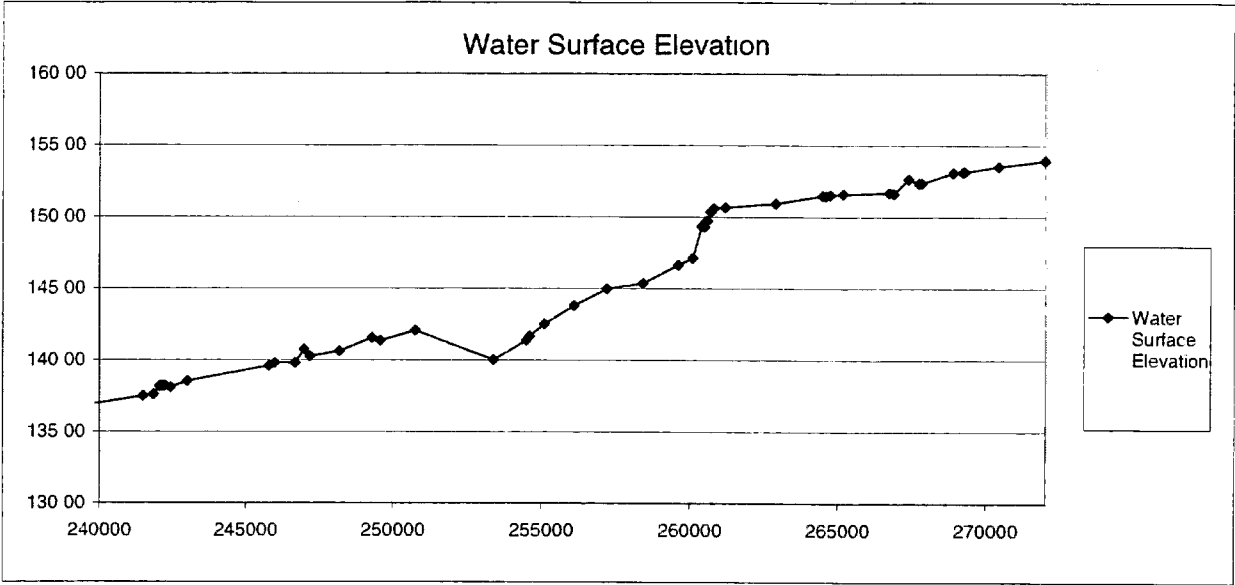
River Station	Computed WSEL (ft)	Computed EGL (ft)	Slope EGL X 10,000	.01 X Conveyance	Total Flowrate (CFS)	Left Overbank Flowrate (CFS)	Channel Flowrate (CFS)	Right Overbank Flowrate (CFS)	% total flow in LOB
212950	127.24	127.67	6.20	119871	298400	173978	115986	8435	58.3%
215700	128.82	129.18	4.84	135699	298400	174728	113349	10323	58.6%
226700	131.70	131.94	3.02	171743	298400	57171	111079	130150	19.2%
234100	133.74	134.19	3.53	158826	298400	66336	173511	58552	22.2%
238900	135.18	135.44	2.27	198029	298400	101246	147503	49651	33.9%
239370	135.27	135.56	2.49	189001	298400	96109	154839	47452	32.2%
239800	135.31	135.72	3.35	163034	298400	73674	170994	53732	24.7%
241500	135.73	136.23	2.71	181425	298400	57205	191046	50149	19.2%
241850	135.82	136.33	2.70	181617	298400	59742	191760	46899	20.0%
242049	136.04	136.42	3.09	169736	298400	33211	140651	124539	11.1%
242050	136.04	136.42	2.94	174044	298400	33894	142005	122501	11.4%
242120	136.06	136.45	2.93	174327	298400	33905	141914	122581	11.4%
242121	136.07	136.45	2.93	174294	298400	33807	141951	122642	11.3%
242169	136.10	136.46	2.86	176600	298400	36749	140208	121444	12.3%
242170	136.09	136.47	2.91	174864	298400	33936	141678	122787	11.4%
242240	136.11	136.49	2.91	174844	298400	33992	141728	122680	11.4%
242241	136.09	136.52	3.17	167679	298400	22894	147597	127909	7.7%
242440	136.21	136.60	3.69	155264	298400	80480	164693	53227	27.0%
243000	136.53	136.78	2.69	181917	298400	96998	139084	62318	32.5%
245800	137.22	137.36	1.66	231897	298400	136984	113578	47838	45.9%
246000	137.28	137.39	1.38	253841	298400	141602	104075	52723	47.5%
246700	137.40	137.50	1.70	228609	298400	179583	92606	26211	60.2%
247000	137.34	137.61	2.60	185060	298400	109637	143302	45461	36.7%
247200	137.38	137.67	2.69	182047	298400	114092	146030	38278	38.2%
248200	137.64	137.95	2.80	178465	298400	114418	137561	46421	38.3%
249300	138.03	138.22	1.92	215132	298400	95088	109971	93341	31.9%
249590	137.98	138.34	3.30	164312	298400	99585	143342	55474	33.4%
250770	138.14	138.98	5.49	127401	298400	75515	183284	39601	25.3%
253400	139.20	141.22	9.80	95341	298400	42629	249604	6167	14.3%
254500	139.82	143.18	14.30	78901	298400	0	295576	2824	0.0%
254600	140.11	143.35	13.75	80474	298400	0	293907	4493	0.0%
255100	141.12	144.09	12.28	85169	298400	1	290790	7610	0.0%
256100	142.59	145.31	10.68	91310	298400	768	290687	6945	0.3%
257200	144.00	146.47	9.35	97612	298400	1773	289459	7168	0.6%
258400	144.50	147.90	9.81	95268	298400	5170	277573	15657	1.7%
259600	145.90	149.03	8.65	101451	298400	5825	276244	16331	2.0%
260100	146.43	149.47	8.26	103815	298400	6077	275750	16574	2.0%
260400	148.74	149.78	2.14	203942	298400	38603	258475	1322	12.9%
260500	148.70	150.06	3.11	169336	298400	0	298400	0	0.0%
260550	149.12	150.46	2.99	172703	298400	0	298400	0	0.0%
260600	149.14	150.47	2.98	172825	298400	0	298400	0	0.0%
260700	149.79	150.55	2.15	203690	298400	0	298400	0	0.0%
260730	149.80	150.56	2.14	203764	298400	0	298400	0	0.0%
260800	150.02	150.77	2.10	206041	298400	0	298400	0	0.0%
261200	150.09	150.86	1.97	212774	298400	5764	270622	22014	1.9%
262900	150.39	151.26	2.41	192259	298400	4861	272453	21086	1.6%
264500	150.96	151.63	2.04	208698	298400	9994	288361	46	3.3%
264600	150.93	151.68	2.20	201333	298400	0	298400	0	0.0%
264750	151.02	151.76	2.17	202367	298400	0	298400	0	0.0%
265200	151.08	151.88	2.21	200535	298400	33952	264448	0	11.4%
266750	151.19	152.37	2.72	176961	292000	3911	286756	1334	1.3%
266900	151.13	152.46	2.90	171592	292000	3963	285779	2258	1.4%
267400	152.18	152.62	0.94	300510	292000	4166	285834	2000	1.4%
267750	151.89	153.02	2.90	171578	292000	0	292000	0	0.0%
267850	151.89	153.02	1.40	246996	292000	0	292000	0	0.0%
268920	152.63	153.19	1.71	223100	292000	0	288377	3623	0.0%
269250	152.69	153.28	3.26	161804	292000	11570	280059	372	4.0%
269300	152.71	153.30	3.25	161969	292000	11577	280050	373	4.0%
270450	153.10	153.63	2.33	191425	292000	0	291848	152	0.0%
272010	153.53	153.98	1.90	211822	292000	1636	286055	4309	0.6%



Model Left Overbank flowrates and WSEL tabulation

Base model for this comparison is the Lexington multiple HEC-2 model, presented by FEMA in Atlanta on 10-18-00. This HEC-2 model assumes the levee has not breached, and conveyance will not occur landward of the levee.

River Station	Computed WSEL (ft)	Computed EGL (ft)	Slope EGL X 10,000	.01 X Conveyance	Total Flowrate (CFS)	Left Overbank Flowrate (CFS)	Channel Flowrate (CFS)	Right Overbank Flowrate (CFS)	% total flow in LOB
212950	127.96	128.42	6.13	120548	298400	167757	120858	9785	56.2%
215700	129.52	129.85	4.42	141905	298400	174506	113106	10788	58.5%
226700	132.48	132.82	3.48	159960	298400	12256	124991	161153	4.1%
234100	135.06	135.66	3.96	149939	298400	27576	197561	73263	9.2%
238900	136.75	137.29	3.40	161795	298400	25820	196034	76546	8.7%
239370	136.89	137.46	3.51	159218	298400	26550	200135	71715	8.9%
239800	136.93	137.69	4.53	140220	298400	5910	217283	75207	2.0%
241500	137.50	138.25	3.14	168381	298400	2651	225389	70360	0.9%
241850	137.59	138.38	3.23	166055	298400	2357	229605	66438	0.8%
242049	138.17	138.55	2.70	181733	298400	1901	146411	150088	0.6%
242050	138.17	138.56	2.59	185521	298400	467	149621	148312	0.2%
242120	138.18	138.58	2.58	185693	298400	467	149572	148361	0.2%
242121	138.19	138.58	2.56	186578	298400	1827	148868	147705	0.6%
242169	138.21	138.59	2.55	186806	298400	1829	148734	147837	0.6%
242170	138.20	138.59	2.57	185964	298400	467	149426	148507	0.2%
242240	138.22	138.61	2.58	185851	298400	468	149562	148370	0.2%
242241	138.23	138.62	2.54	187085	298400	1788	148619	147994	0.6%
242440	138.10	138.88	4.17	146213	298400	2594	218972	76834	0.9%
243000	138.54	139.13	4.11	147263	298400	3913	192536	101951	1.3%
245800	139.59	140.17	3.81	152934	298400	3524	196150	98726	1.2%
246000	139.79	140.25	3.20	166861	298400	3587	181734	113079	1.2%
246700	139.80	140.70	6.81	114359	298400	5321	214107	78973	1.8%
247000	140.76	140.79	0.00	*****	298400	134970	58944	104486	45.2%
247200	140.26	141.01	4.31	143744	298400	2721	216127	79552	0.9%
248200	140.62	141.49	4.69	137715	298400	4805	207302	86294	1.6%
249300	141.56	141.89	2.25	199097	298400	4303	142497	151600	1.4%
249590	141.35	142.11	4.35	143074	298400	6911	195983	95506	2.3%
250770	142.07	142.17	0.00	*****	298400	125926	82058	90416	42.2%
253400	140.03	143.05	12.21	85399	298400	2597	290353	5450	0.9%
254500	141.38	144.40	12.22	85373	298400	1	294251	4148	0.0%
254600	141.67	144.55	11.68	87325	298400	2	291635	6764	0.0%
255100	142.51	145.18	10.62	91580	298400	5	288402	9994	0.0%
256100	143.79	146.24	9.37	97484	298400	1985	287266	9149	0.7%
257200	144.97	147.26	8.46	102584	298400	3014	287240	8146	1.0%
258400	145.36	148.60	9.07	99061	298400	5571	276752	16077	1.9%
259600	146.65	149.65	8.10	104818	298400	6183	275542	16674	2.1%
260100	147.14	150.05	7.77	107041	298400	6420	275088	16892	2.2%
260400	149.36	150.35	2.01	210534	298400	40551	256520	1330	13.6%
260500	149.32	150.64	2.93	174314	298400	0	298400	0	0.0%
260550	149.72	151.01	2.82	177545	298400	0	298400	0	0.0%
260600	149.74	151.03	2.82	177661	298400	0	298400	0	0.0%
260700	150.38	151.11	2.02	209730	298400	0	298400	0	0.0%
260730	150.38	151.11	2.02	209802	298400	0	298400	0	0.0%
260800	150.59	151.31	1.98	211984	298400	0	298400	0	0.0%
261200	150.66	151.40	1.86	219076	298400	6046	270048	22306	2.0%
262900	150.94	151.78	2.27	198055	298400	5119	271922	21359	1.7%
264500	151.48	152.13	1.92	215236	298400	10400	287948	53	3.5%
264600	151.45	152.17	2.07	207333	298400	0	298400	0	0.0%
264750	151.53	152.25	2.05	208329	298400	0	298400	0	0.0%
265200	151.59	152.36	2.10	206112	298400	34667	263733	0	11.6%
266750	151.69	152.83	2.59	181336	292000	4400	286138	1462	1.5%
266900	151.63	152.92	2.76	175842	292000	4466	285077	2457	1.5%
267400	152.64	153.08	0.90	306962	292000	4326	285587	2087	1.5%
267750	152.36	153.46	2.76	175733	292000	0	292000	0	0.0%
267850	152.36	153.46	1.34	252673	292000	0	292000	0	0.0%
268920	153.08	153.62	1.63	228867	292000	0	288337	3663	0.0%
269250	153.14	153.71	3.12	165403	292000	11730	279875	395	4.0%
269300	153.15	153.72	3.11	165561	292000	11737	279867	396	4.0%
270450	153.53	154.04	2.18	197709	292000	0	291831	169	0.0%
272010	153.93	154.37	1.79	218104	292000	1697	285930	4373	0.6%



Comparison of Levee elevations versus revised Lexington BFE HEC-2 Model

River Station	Field Survey top of levee EL	FEMA 10/18/00 Lexington Multiple BFE HEC-2 WSEL	LXMUL.DAT Revised Multiple BFE HEC-2 WSEL	Freeboard to FEMA 10/18/00 Lex. BFE	Freeboard to revised LXMUL.DAT Lex. BFE
234100	142.70	135.06	135.06	7.64	7.64
238900	142.80	136.75	136.75	6.05	6.05
239370	137.30	136.89	136.89	0.41	0.41
239800	137.10	136.93	136.93	0.17	0.17
241500	142.30	137.50	137.50	4.80	4.80
241850	148.00	137.59	137.59	10.41	10.41
242049	153.00	138.17	138.17	14.83	14.83
242050	153.00	138.17	138.17	14.83	14.83
242120	153.00	138.18	138.18	14.82	14.82
242121	153.00	138.19	138.19	14.81	14.81
242169	153.00	138.21	138.21	14.79	14.79
242170	153.00	138.20	138.20	14.80	14.80
242240	150.60	138.22	138.22	12.38	12.38
242241	150.60	138.23	138.23	12.37	12.37
242440	147.20	138.10	138.10	9.10	9.10
243000	147.10	138.54	138.54	8.56	8.56
245800	145.40	139.59	139.59	5.81	5.81
246000	144.80	139.79	139.79	5.01	5.01
246700	140.70	139.80	139.76	0.90	0.94
247000	142.40	140.76	140.25	1.64	2.15
247200	142.20	140.26	140.25	1.94	1.95
248200	145.40	140.62	140.62	4.78	4.78
249300	142.00	141.56	141.56	0.44	0.44
249590	145.40	141.35	141.35	4.05	4.05
250770	149.30	142.07	141.57	7.23	7.73
253400	147.80	140.03	142.72	7.77	5.08
254500	151.00	141.38	143.68	9.62	7.32

Note: Bold numbers under levee top elevation are elevations taken from HEC-2 model (aerial topo information). All others are field verified top elevations.

Lexington HEC-2 model BFE sensitivity

The purpose of this comparison is to model the sensitivity of the Lexington multiple model to changes in the channel "n" value at section 246700. The FEMA multiple model of 10-18-00 sets the "n" value at 0.040. The revised Lexington multiple model sets the "n" value at 0.038.

River Station	10-18-00 FEMA Lexington Multiple BFE (ft, MSL)	Revised Lexington Multiple BFE (ft, MSL)	Difference (feet)
212950	127.96	127.96	0.00
215700	129.52	129.52	0.00
226700	132.48	132.48	0.00
234100	135.06	135.06	0.00
238900	136.75	136.75	0.00
239370	136.89	136.89	0.00
239800	136.93	136.93	0.00
241500	137.50	137.50	0.00
241850	137.59	137.59	0.00
242049	138.17	138.17	0.00
242050	138.17	138.17	0.00
242120	138.18	138.18	0.00
242121	138.19	138.19	0.00
242169	138.21	138.21	0.00
242170	138.20	138.20	0.00
242240	138.22	138.22	0.00
242241	138.23	138.23	0.00
242440	138.10	138.10	0.00
243000	138.54	138.54	0.00
245800	139.59	139.59	0.00
246000	139.79	139.79	0.00
246700	139.80	139.76	-0.04
247000	140.76	140.77	0.01
247200	140.26	140.27	0.01
248200	140.62	140.63	0.01
249300	141.56	141.57	0.01
249590	141.35	141.36	0.01
250770	142.07	142.08	0.01
253400	140.03	140.03	0.00
254500	141.38	141.39	0.01
254600	141.67	141.67	0.00
255100	142.51	142.52	0.01
256100	143.79	143.80	0.01
257200	144.97	144.98	0.01
258400	145.36	145.37	0.01
259600	146.65	146.66	0.01
260100	147.14	147.14	0.00
260400	149.36	149.37	0.01
260500	149.32	149.33	0.01
260550	149.72	149.73	0.01
260600	149.74	149.74	0.00

Lexington HEC-2 model BFE sensitivity

The purpose of this comparison is to model the sensitivity of the Lexington multiple model to changes in the channel "n" value at section 246700. The FEMA multiple model of 10-18-00 sets the "n" value at 0.040. The revised Lexington multiple model sets the "n" value at 0.038.

River Station	10-18-00 FEMA Lexington Multiple BFE (ft, MSL)	Revised Lexington Multiple BFE (ft, MSL)	Difference (feet)
260700	150.38	150.38	0.00
260730	150.38	150.39	0.01
260800	150.59	150.60	0.01
261200	150.66	150.66	0.00
262900	150.94	150.94	0.00
264500	151.48	151.48	0.00
264600	151.45	151.45	0.00
264750	151.53	151.54	0.01
265200	151.59	151.59	0.00
266750	151.69	151.69	0.00
266900	151.63	151.63	0.00
267400	152.64	152.65	0.01
267750	152.36	152.36	0.00
267850	152.36	152.36	0.00
268920	153.08	153.08	0.00
269250	153.14	153.14	0.00
269300	153.15	153.16	0.01
270450	153.53	153.53	0.00
272010	153.93	153.93	0.00

Lexington HEC-2 Multiple Model

This sheet compares BFE's for the Lexington HEC-2 models. The comparisons shown here are for the FEMA 10-18-00 Lexington BFE model, the revised Lexington multiple HEC-2 model , and the revised Lexington floodway model.

River Station	Model Results			Differences	
	10/18/00 FEMA Lexington BFE	Revised Lexington Multiple BFE	Revised Lexington Floodway BFE	10/18/00 Multiple BFE	Revised Mult to Floodway BFE
212950	127.96	127.96	127.96	0.00	0.00
215700	129.52	129.52	129.52	0.00	0.00
226700	132.48	132.48	132.48	0.00	0.00
234100	135.06	135.06	135.06	0.00	0.00
238900	136.75	136.75	136.75	0.00	0.00
239370	136.89	136.89	136.89	0.00	0.00
239800	136.93	136.93	136.93	0.00	0.00
241500	137.50	137.50	137.50	0.00	0.00
241850	137.59	137.59	137.59	0.00	0.00
242049	138.17	138.17	138.17	0.00	0.00
242050	138.17	138.17	138.17	0.00	0.00
242120	138.18	138.18	138.18	0.00	0.00
242121	138.19	138.19	138.19	0.00	0.00
242169	138.21	138.21	138.21	0.00	0.00
242170	138.20	138.20	138.20	0.00	0.00
242240	138.22	138.22	138.22	0.00	0.00
242241	138.23	138.23	138.23	0.00	0.00
242440	138.10	138.10	138.10	0.00	0.00
243000	138.54	138.54	138.54	0.00	0.00
245800	139.59	139.59	139.59	0.00	0.00
246000	139.79	139.79	139.79	0.00	0.00
246700	139.80	139.76	139.76	-0.04	0.00
247000	140.76	140.25	140.25	-0.51	0.00
247200	140.26	140.25	140.25	-0.01	0.00
248200	140.62	140.62	140.62	0.00	0.00
249300	141.56	141.56	141.56	0.00	0.00
249590	141.35	141.35	141.35	0.00	0.00
250770	142.07	141.57	141.57	-0.50	0.00
253400	140.03	142.72	142.72	2.69	0.00
254500	141.38	143.68	143.68	2.30	0.00
254600	141.67	143.96	143.96	2.29	0.00
255100	142.51	144.63	144.63	2.12	0.00
256100	143.79	145.61	145.61	1.82	0.00
257200	144.97	146.60	146.60	1.63	0.00
258400	145.36	146.82	146.82	1.46	0.00
259600	146.65	147.94	147.94	1.29	0.00
260100	147.14	148.37	148.37	1.23	0.00
260400	149.36	150.46	150.46	1.10	0.00
260500	149.32	150.41	150.41	1.09	0.00

Lexington HEC-2 Multiple Model

This sheet compares BFE's for the Lexington HEC-2 models. The comparisons shown here are for the FEMA 10-18-00 Lexington BFE model, the revised Lexington multiple HEC-2 model , and the revised Lexington floodway model.

River Station	Model Results			Differences	
	10/18/00 FEMA Lexington BFE	Revised Lexington Multiple BFE	Revised Lexington Floodway BFE	10/18/00 Multiple BFE	Revised Mult to Floodway BFE
260550	149.72	150.78	150.78	1.06	0.00
260600	149.74	150.79	150.79	1.05	0.00
260700	150.38	151.40	151.40	1.02	0.00
260730	150.38	151.41	151.41	1.03	0.00
260800	150.59	151.60	151.60	1.01	0.00
261200	150.66	151.66	151.66	1.00	0.00
262900	150.94	151.91	151.91	0.97	0.00
264500	151.48	152.40	152.40	0.92	0.00
264600	151.45	152.37	152.37	0.92	0.00
264750	151.53	152.45	152.45	0.92	0.00
265200	151.59	152.50	152.50	0.91	0.00
266750	151.69	152.58	152.58	0.89	0.00
266900	151.63	152.53	152.53	0.90	0.00
267400	152.64	153.47	153.47	0.83	0.00
267750	152.36	153.20	153.20	0.84	0.00
267850	152.36	153.20	153.20	0.84	0.00
268920	153.08	153.88	153.88	0.80	0.00
269250	153.14	153.94	153.94	0.80	0.00
269300	153.15	153.95	153.95	0.80	0.00
270450	153.53	154.31	154.31	0.78	0.00
272010	153.93	154.67	154.67	0.74	0.00

Richland HEC-2 Multiple Model

This sheet compares BFE's for the Richland HEC-2 models. The comparisons shown here are for the FEMA 10-18-00 models, multiple and floodway runs. These results are for "out of the box" models, no modifications have been made.

River Station	Richland Multiple BFE	Richland FW BFE	Difference (feet)
212950	127.24	127.24	0.00
215700	128.82	128.82	0.00
226700	131.70	131.70	0.00
234100	133.74	133.74	0.00
238900	135.18	135.18	0.00
239370	135.27	135.27	0.00
239800	135.31	135.31	0.00
241500	135.73	135.73	0.00
241850	135.82	135.82	0.00
242049	136.04	136.04	0.00
242050	136.04	136.04	0.00
242120	136.06	136.06	0.00
242121	136.07	136.07	0.00
242169	136.10	136.10	0.00
242170	136.09	136.09	0.00
242240	136.11	136.11	0.00
242241	136.09	136.09	0.00
242440	136.21	136.21	0.00
243000	136.53	136.53	0.00
245800	137.22	137.22	0.00
246000	137.28	137.28	0.00
246700	137.40	137.40	0.00
247000	137.34	137.34	0.00
247200	137.38	137.38	0.00
248200	137.64	137.64	0.00
249300	138.03	138.03	0.00
249590	137.98	137.98	0.00
250770	138.14	138.14	0.00
253400	139.20	139.20	0.00
254500	139.82	139.82	0.00
254600	140.11	140.11	0.00
255100	141.12	141.12	0.00
256100	142.59	142.59	0.00
257200	144.00	144.00	0.00
258400	144.50	144.50	0.00
259600	145.90	145.90	0.00
260100	146.43	146.43	0.00
260400	148.74	148.74	0.00
260500	148.70	148.70	0.00

Richland HEC-2 Multiple Model

This sheet compares BFE's for the Richland HEC-2 models. The comparisons shown here are for the FEMA 10-18-00 models, multiple and floodway runs. These results are for "out of the box" models, no modifications have been made.

River Station	Richland Multiple BFE	Richland FW BFE	Difference (feet)
260550	149.12	149.12	0.00
260600	149.14	149.14	0.00
260700	149.79	149.79	0.00
260730	149.80	149.80	0.00
260800	150.02	150.02	0.00
261200	150.09	150.09	0.00
262900	150.39	150.39	0.00
264500	150.96	150.96	0.00
264600	150.93	150.93	0.00
264750	151.02	151.02	0.00
265200	151.08	151.08	0.00
266750	151.19	151.19	0.00
266900	151.13	151.13	0.00
267400	152.18	152.18	0.00
267750	151.89	151.89	0.00
267850	151.89	151.89	0.00
268920	152.63	152.63	0.00
269250	152.69	152.69	0.00
269300	152.71	152.71	0.00
270450	153.10	153.10	0.00
272010	153.53	153.53	0.00

Information for floodway sketch

Model comparisons for floodway sketch of Lexington County

River Station	Calc'd -CL- Station	09/26/00		10/18/00		Revised Lex.		Lexington Mapping Information			Difference, 9/26/00 FEMA to 10/18/00 FEMA	Difference, 10/18/00 FEMA Rev. Lexington
		FEMA Models		FEMA Models		Floodway Model		9/26/00 FEMA Dist -CL- to FW	10/18/00 FEMA Dist -CL- to FW	Rev. Lexington Dist -CL- to FW		
		Left Encr. Sta.	Right Encr. Sta.	Left Encr. Sta.	Right Encr. Sta.	Left Encr. Sta.	Right Encr. Sta.					
212950	22475	9085.78	22750.00	9139.38	22974.60	9139.38	22974.60	275.00	499.60	499.60	224.60	0.00
215700	22475	8033.87	22913.72	8030.57	22914.93	8030.57	22914.93	438.72	439.93	439.93	1.21	0.00
226700	20000	10117.33	25749.53	10079.12	25766.09	10079.12	25766.09	5750.03	5766.59	5766.59	16.56	0.00
234100	20000	5550.00	22656.00	5550.00	22656.00	15014.00	22656.00	2656.00	2656.00	2656.00	0.00	0.00
238900	30285	19835.00	35900.00	19835.00	35900.00	28331.00	35900.00	5615.00	5615.00	5615.00	0.00	0.00
239370	30285	21160.00	35900.00	21160.00	35900.00	28331.00	35900.00	5615.00	5615.00	5615.00	0.00	0.00
239800	10000	560.00	15700.00	560.00	15700.00	9030.00	15700.00	5700.00	5700.00	5700.00	0.00	0.00
241500	12700	6356.79	18683.86	6342.05	18692.54	12061.00	18692.54	5983.86	5992.54	5992.54	8.68	0.00
241850	12700	6408.50	18859.09	6399.08	18865.33	12104.00	18865.33	6159.09	6165.33	6165.33	6.24	0.00
242049	11440	5540.00	17240.00	5540.00	17240.00	10815.00	17240.00	5800.00	5800.00	5800.00	0.00	0.00
242050	11440	5540.00	17240.00	5540.00	17240.00	10815.00	17240.00	5800.00	5800.00	5800.00	0.00	0.00
242120	11440	5540.00	17240.00	5540.00	17240.00	10815.00	17240.00	5800.00	5800.00	5800.00	0.00	0.00
242121	11440	5540.00	17240.00	5540.00	17240.00	10815.00	17240.00	5800.00	5800.00	5800.00	0.00	0.00
242169	11429	5540.00	17240.00	5540.00	17240.00	10793.00	17240.00	5811.00	5811.00	5811.00	0.00	0.00
242170	11429	5540.00	17240.00	5540.00	17240.00	10793.00	17240.00	5811.00	5811.00	5811.00	0.00	0.00
242240	11436	5540.00	17240.00	5540.00	17240.00	10806.00	17240.00	5804.50	5804.50	5804.50	0.00	0.00
242241	11436	5540.00	17240.00	5540.00	17240.00	10806.00	17240.00	5804.50	5804.50	5804.50	0.00	0.00
242440	12363	5540.00	17600.00	5540.00	17600.00	11800.00	17600.00	5237.50	5237.50	5237.50	0.00	0.00
243000	12413	6437.81	17864.96	6452.90	17859.61	11830.00	17859.61	5452.46	5447.11	5447.11	-5.35	0.00
245800	12413	5580.00	17300.00	5580.00	17300.00	11800.00	17300.00	4887.50	4887.50	4887.50	0.00	0.00
246000	12413	5614.04	17143.13	5589.08	17131.80	11815.00	17131.80	4730.63	4719.30	4719.30	-11.33	0.00
246700	15000	8900.00	18800.00	8900.00	18800.00	14467.00	19200.00	3800.00	3800.00	4200.00	0.00	400.00
247000	19313	12726.80	23275.22	12729.02	23282.54	18790.00	23582.00	3962.72	3970.04	4269.50	7.32	299.46
247200	19313	12442.06	23303.16	12445.06	23301.65	18800.00	23601.00	3990.66	3989.15	4288.50	-1.51	299.35
248200	13338	6352.97	17570.07	6340.41	17582.96	12860.00	17682.00	4232.07	4244.96	4344.00	12.89	99.04
249300	10000	4220.45	13995.86	4222.68	13994.81	9390.00	14400.00	3995.86	3994.81	4400.00	-1.05	405.19
249590	13338	7574.81	17209.71	7576.92	17206.01	12740.00	17306.00	3871.71	3868.01	3968.00	-3.70	99.99
250770	6392	1618.34	10226.07	1620.16	10222.71	5910.00	10222.71	3834.07	3830.71	3830.71	-3.36	0.00
253400	10000	7628.00	12000.00	7628.00	12000.00	9590.00	12000.00	2000.00	2000.00	2000.00	0.00	0.00
254500	5000	4685.00	5315.00	4685.00	5315.00	4685.00	5315.00	315.00	315.00	315.00	0.00	0.00
254600	5000	4685.00	5315.00	4685.00	5315.00	4685.00	5315.00	315.00	315.00	315.00	0.00	0.00
255100	5000	4685.00	5315.00	4685.00	5315.00	4685.00	5315.00	315.00	315.00	315.00	0.00	0.00
256100	5000	4685.00	5315.00	4685.00	5315.00	4685.00	5315.00	315.00	315.00	315.00	0.00	0.00
257200	5000	4685.00	5315.00	4685.00	5316.53	4685.00	5316.53	315.00	316.53	316.53	1.53	0.00
258400	6437	6173.37	6773.76	6172.70	6774.11	6172.70	6774.11	336.76	337.11	337.11	0.35	0.00
259600	6437	6167.07	6778.51	6166.49	6778.74	6166.49	6778.74	341.51	341.74	341.74	0.23	0.00
260100	6437	6169.04	6773.53	6168.58	6773.78	6168.58	6773.78	336.53	336.78	336.78	0.25	0.00
260400	6345	5613.58	6689.00	5607.88	6689.00	5607.88	6689.00	344.50	344.50	344.50	0.00	0.00
260500	2018	1570.00	2465.00	1570.00	2465.00	1570.00	2465.00	447.50	447.50	447.50	0.00	0.00
260550	2018	1570.00	2465.00	1570.00	2465.00	1570.00	2465.00	447.50	447.50	447.50	0.00	0.00
260600	2018	1570.00	2465.00	1570.00	2465.00	1570.00	2465.00	447.50	447.50	447.50	0.00	0.00
260700	1865	1510.00	2730.00	1510.00	2730.00	1510.00	2730.00	865.00	865.00	865.00	0.00	0.00

Model comparisons for floodway sketch of Lexington County

River Station	Calc'd -CL- Station	09/26/00 FEMA Models		10/18/00 FEMA Models		Revised Lex. Floodway Model		Lexington Mapping Information			Difference, 9/26/00 FEMA to 10/18/00 FEMA	Difference, 10/18/00 FEMA Rev. Lexington
		Left Encr. Sta.	Right Encr. Sta.	Left Encr. Sta.	Right Encr. Sta.	Left Encr. Sta.	Right Encr. Sta.	9/26/00 FEMA Dist -CL- to FW	10/18/00 FEMA Dist -CL- to FW	Rev. Lexington Dist -CL- to FW		
260730	1865	1510.00	2730.00	1510.00	2730.00	1510.00	2730.00	865.00	865.00	865.00	0.00	0.00
260800	1865	1510.00	2730.00	1510.00	2730.00	1510.00	2730.00	865.00	865.00	865.00	0.00	0.00
261200	903	370.00	1682.84	370.00	1684.83	370.00	1684.83	780.34	782.33	782.33	1.99	0.00
262900	903	325.39	1710.39	323.30	1710.50	323.30	1710.50	807.89	808.00	808.00	0.11	0.00
264500	2395	1660.00	3130.00	1660.00	3130.00	1660.00	3130.00	735.00	735.00	735.00	0.00	0.00
264600	2395	1660.00	3130.00	1660.00	3130.00	1660.00	3130.00	735.00	735.00	735.00	0.00	0.00
264750	2395	1660.00	3130.00	1660.00	3130.00	1660.00	3130.00	735.00	735.00	735.00	0.00	0.00
265200	1753	1177.88	2285.00	1175.73	2285.00	1175.73	2285.00	532.50	532.50	532.50	0.00	0.00
266750	5033	4289.35	5471.00	4287.44	5471.00	4287.44	5471.00	438.00	438.00	438.00	0.00	0.00
266900	5000	4595.00	5405.00	4595.00	5405.00	4595.00	5405.00	405.00	405.00	405.00	0.00	0.00
267400	1526	821.50	2231.30	821.50	2231.30	821.50	2231.30	704.90	704.90	704.90	0.00	0.00
267750	5000	4475.00	5525.00	4475.00	5525.00	4475.00	5525.00	525.00	525.00	525.00	0.00	0.00
267850	1282	563.00	2000.00	563.00	2000.00	563.00	2000.00	718.50	718.50	718.50	0.00	0.00
268920	5088	4260.00	5915.00	4260.00	5915.00	4260.00	5915.00	827.50	827.50	827.50	0.00	0.00
269250	1424	600.00	2248.00	600.00	2248.00	600.00	2248.00	824.00	824.00	824.00	0.00	0.00
269300	1424	600.00	2248.00	600.00	2248.00	600.00	2248.00	824.00	824.00	824.00	0.00	0.00
270450	5000	3835.00	6165.00	3835.00	6165.00	3835.00	6165.00	1165.00	1165.00	1165.00	0.00	0.00
272010	4135	2970.00	5300.00	2970.00	5300.00	2970.00	5300.00	1165.00	1165.00	1165.00	0.00	0.00

Calculation of cross section centerline stations

River Station	Left Top Bank	Right Top Bank	Stream -CL-
212950	22200	22750	22475
215700	22200	22750	22475
226700	19665	20334	20000
234100	19585	20415	20000
238900	29870	30700	30285
239370	29870	30700	30285
239800	9575	10425	10000
241500	12275	13125	12700
241850	12275	13125	12700
242049	10815	12065	11440
242050	10815	12065	11440
242120	10815	12065	11440
242121	10815	12065	11440
242169	10793	12065	11429
242170	10793	12065	11429
242240	10806	12065	11436
242241	10806	12065	11436
242440	11900	12825	12363
243000	12000	12825	12413
245800	12000	12825	12413
246000	12000	12825	12413
246700	14587	15413	15000
247000	18900	19725	19313
247200	18900	19725	19313
248200	13000	13676	13338
249300	9662	10338	10000
249590	13000	13676	13338
250770	6089	6695	6392
253400	9697	10303	10000
254500	4685	5315	5000
254600	4685	5315	5000
255100	4685	5315	5000
256100	4685	5315	5000
257200	4685	5315	5000
258400	6209	6665	6437
259600	6209	6665	6437
260100	6209	6665	6437
260400	6000	6689	6345
260500	1570	2465	2018
260550	1570	2465	2018
260600	1570	2465	2018
260700	1000	2730	1865
260730	1000	2730	1865
260800	1000	2730	1865
261200	370	1435	903
262900	370	1435	903

Calculation of cross section centerline stations

River Station	Left Top Bank	Right Top Bank	Stream -CL-
264500	1660	3130	2395
264600	1660	3130	2395
264750	1660	3130	2395
265200	1220	2285	1753
266750	4595	5471	5033
266900	4595	5405	5000
267400	821.5	2231.3	1526
267750	4475	5525	5000
267850	563	2000	1282
268920	4260	5915	5088
269250	600	2248	1424
269300	600	2248	1424
270450	3835	6165	5000
272010	2970	5300	4135

Levee Top Elevation Adjustment

This is a brief calculation of the overall fill required to bring the levee top elevation to the required height to maintain FEMA freeboard requirements.

Freeboard Requirement (per FEMA 37) ==>

- 1) A minimum freeboard requirement of three (3) feet is necessary along the entire levee.
- 2) An additional one (1) foot of freeboard is required within 100' of structures within the levee or wherever flow is restricted, such as bridges (in this case, I-77).
- 3) An additional one-half (0.5) foot of freeboard is required at the upstream end of the levee.

Richland County Requirements ==>

- 1) Top of levee elevation must be equal or greater than the 500-year elevation plus three (3) feet.

River Station	100 yr. HEC-2 WSEL	500 yr. HEC-2 WSEL	Existing Levee Top Elevation	Present Freeboard 100-year (feet)	Present Freeboard 500-year (feet)	100-year Freeboard Required (feet)	500-year Freeboard Required (feet)	Min.Elev. for 100-year (ft, MSL)	Min.Elev. for 500-year (ft, MSL)	Calc'd New Min. Levee Top Elevation	Levee top input to HEC-2 Model	Comments	Levee Increase
234100	135.06	138.48	142.70	7.64	4.22	3.00	3.00	138.06	141.48	same	same	End of Levee	0.00
238900	136.75	140.54	142.80	6.05	2.26	3.00	3.00	139.75	143.54	143.54	143.60		0.80
239370	136.89	140.71	137.30	0.41	-3.41	3.00	3.00	139.89	143.71	143.71	143.80		6.50
239800	136.93	140.68	137.10	0.17	-3.58	3.00	3.00	139.93	143.68	143.68	143.80		6.70
241500	137.50	141.49	142.30	4.80	0.81	3.00	3.00	140.50	144.49	144.49	144.50		2.20
241850	137.59	141.60	148.00	10.41	6.40	3.00	3.00	140.59	144.60	same	same		0.00
242049	138.17	142.48	153.00	14.83	10.52	4.00	3.00	142.17	145.48	same	same	I-77 Section	0.00
242050	138.17	142.47	153.00	14.83	10.53	4.00	3.00	142.17	145.47	same	same	I-77 Section	0.00
242120	138.18	142.49	153.00	14.82	10.51	4.00	3.00	142.18	145.49	same	same	I-77 Section	0.00
242121	138.19	142.50	153.00	14.81	10.50	4.00	3.00	142.19	145.50	same	same	I-77 Section	0.00
242169	138.21	142.52	153.00	14.79	10.48	4.00	3.00	142.21	145.52	same	same	I-77 Section	0.00
242170	138.20	142.51	153.00	14.80	10.49	4.00	3.00	142.20	145.51	same	same	I-77 Section	0.00
242240	138.22	142.53	150.60	12.38	8.07	4.00	3.00	142.22	145.53	same	same	I-77 Section	0.00
242241	138.23	142.56	150.60	12.37	8.04	4.00	3.00	142.23	145.56	same	same	I-77 Section	0.00

Levee Top; Revised Lex Model

River Station	100 yr. HEC-2 WSEL	500 yr. HEC-2 WSEL	Existing Levee Top Elevation	Present Freeboard 100-year (feet)	Present Freeboard 500-year (feet)	100-year Freeboard Required (feet)	500-year Freeboard Required (feet)	Min.Elev. for 100-year (ft, MSL)	Min.Elev. for 500-year (ft, MSL)	Calc'd New Min. Levee Top Elevation	Levee top input to HEC-2 Model	Comments	Levee Increase
242440	138.10	142.35	147.20	9.10	4.85	3.00	3.00	141.10	145.35	same	same		0.00
243000	138.54	142.97	147.10	8.56	4.13	3.00	3.00	141.54	145.97	same	same		0.00
245800	139.59	144.14	145.40	5.81	1.26	3.00	3.00	142.59	147.14	147.14	147.20		1.80
246000	139.79	144.43	144.80	5.01	0.37	3.00	3.00	142.79	147.43	147.43	147.50		2.70
246700	139.76	144.35	140.70	0.94	-3.65	3.00	3.00	142.76	147.35	147.35	147.50		6.80
247000	140.25	144.98	142.40	2.15	-2.58	3.00	3.00	143.25	147.98	147.98	148.00		5.60
247200	140.25	144.95	142.20	1.95	-2.75	3.00	3.00	143.25	147.95	147.95	148.00		5.80
248200	140.62	145.27	145.40	4.78	0.13	3.00	3.00	143.62	148.27	148.27	148.30		2.90
249300	141.56	146.50	142.00	0.44	-4.50	3.00	3.00	144.56	149.50	149.50	149.50		7.50
249590	141.35	146.19	145.40	4.05	-0.79	3.00	3.00	144.35	149.19	149.19	149.50		4.10
250770	141.57	146.41	149.30	7.73	2.89	3.00	3.00	144.57	149.41	149.41	149.50		0.20
253400	142.72	147.51	147.80	5.08	0.29	3.00	3.00	145.72	150.51	150.51	150.60		2.80
254500	143.68	148.68	151.00	7.32	2.32	3.50	3.00	147.18	151.68	151.68	151.70	End Levee	0.70